"San Francisco's Water Supplies"
(Map included)

Taken from the San Francisco
Municipal Report, 1874-1875

Appendix.

BOARD OF SUPERVISORS

OF THE

CITY AND COUNTY OF SAN FRANCISCO,

1874-'75.

MAYOR AND EX-OFFICIO PRESIDENT, JAMES OTIS.

MEMBERS.

1st Ward, STEWART MENZIES.	7th Ward, JAS. B. ROBERTS.
2d Ward, W. C. PEASE.	8th Ward, ABRAM BLOCK.
3d Ward, JAS. J. KENNEY.	9th Ward, A. W. SCOTT.
4th Ward, A. M. EBBETS.	10th Ward, GEO. HEWSTON.
5th Ward, JNO. R. SIMS.	11th Ward, M. LYNCH.
6th Ward, JAS. H. DEERING.	12th Ward, D. A. MACDONALD.

STANDING COMMITTEES.

Judiciary.....MENZIES, ROBERTS, LYNCH.
Finance and Auditing.....EBBETS, MENZIES, ROBERTS.
Fire and Water.....LYNCH, MACDONALD, SCOTT.
Streets, Wharves, etc.....SCOTT, MENZIES, MACDONALD.
Public Buildings.....MACDONALD, PEASE, SIMS.
Health and Police.....BLOCK, HEWSTON, KENNEY.
License and Orders.....DEERING, LYNCH, BLOCK.
Hospital.....HEWSTON, DEERING, ROBERTS.
Printing and Salaries.....PEASE, EBBETS, BLOCK.
Industrial School.....ROBERTS, DEERING, EBBETS.
Fire Alarm.....SIMS, KENNEY, HEWSTON.
Street Lights.....KENNEY, SIMS, SCOTT.
Outside Lands... LYNCH, MENZIES, MACDONALD, KENNEY, SCOTT.

SPECIAL COMMITTEE.

Water Supply....DEERING, LYNCH, SCOTT, MACDONALD, EBBETS.

General Map
OF THE SURVEYS FOR THE
SAN FRANCISCO WATER SUPPLY
MADE UNDER THE DIRECTION OF THE
BOARD OF SUPERVISORS
PURSUANT TO AND UNDER THE AUTHORITY OF
by
T. R. SCOWDEN
Chief Engineer
Scale 6 miles to 1 inch
C. F. ALLARDT
First Ass't Engineer
COLUSA
MARYSVILLE
NEVADA CITY
CARSON CITY
LAKE TAHOE
STATE OF NEVADA
LAKEPORT
CLEAR LAKE
UNCLE SAM
CANAL
CONDUIT BEGINS
CALISTOGA
CLEAR LAKE DIVISION
CONDUIT
NAPA
EXPLORED ROUTE
SACRAMENTO
FOLSOM
AUBURN
PLACERVILLE
BLUE LAKES
CANAL
DOWN NATURAL BED OF MOKELUMNE R.
JACKSON
CLARKS DITCH
CONDUIT BEGINS
BLUE LAKES DIVISION
CONDUIT
STOCKTON
SONORA
MARIPOSA
MERCED
MODESTO
SANTA ROSA
PETALUMA
SAN RAFAEL
MARTINEZ
OAKLAND
SAN FRANCISCO
SAN JOSE
CALAVERAS DIVISION
CALAVERAS RESERVOIR
PESCADERO DIVISION
CONTRA COSTA
ALAMEDA
SAN MATEO
SANTA CLARA
MARIN
YOLO
SOLANO
NAPA
LAKE
SUTTER
YUBA
PLACER
EL DORADO
AMADOR
ALPINE
CALAVERAS
TUOLUMNE
SAN JOAQUIN
STANISLAUS
MERCED
MARIPOSA
PACIFIC OCEAN

WATER SUPPLIES.

The importance of securing an abundant supply of pure fresh water for the use of the inhabitants of this city and county, has been a subject that has engaged the attention of the Board of Supervisors during the last six or seven years, it being the prevailing opinion that the city should acquire and own the water-works, and such supplies of water as would meet the present and future wants for the next fifty years, not alone for all classes of our population, but for cleansing our sewers, watering streets, and for fire extinguishing purposes.

It may be a matter of surprise that so important a want, so great a necessity as a bountiful cheap supply of pure fresh water, should not have demanded and secured that attention and legislation necessary to have enabled the city and county to have acquired and had water-works in operation prior to this time, and before speculators had operated and acquired a title to the many available sources of supply.

In the year 1871 a Special Committee of the Board, consisting of Supervisors A. B. Forbes, Stewart Menzies, and Alex. Badlam, Jr., was appointed to examine and report upon the various available sources of water supplies, and after an examination and consideration of these, and of various propositions that had been submitted to the Board by private parties to bring from distant points supplies of water, and after consultations with B. S. Alexander, Lieutenant-Colonel of Engineers, Brevet Brigadier-General U. S. A., and Professor Geo. Davidson, Superintendent of the U. S. Coast Survey, as to the water supply of the peninsula of San Francisco, presented a report on December 11th, of that year, of which the following is the summary and recommendations made:

"Your Committee are of opinion: That there is an abundant supply of good fresh water on this peninsula, available at sufficient elevation and within a reasonable distance from this city, to meet all the wants of any population San Francisco will probably have within the next fifty years; and, therefore, it is unecessary to look for a supply to distant sources, entailing a large outlay, with serious difficulties to overcome, and liable to frequent accidental interruptions.

"That the cost of works to introduce the water supply from this peninsula will not be excessive, but in the absence of any special survey for this purpose, only an approximate estimate of such cost can now be reached; a detailed survey of route should be made, including the necessary examination of sites for reservoirs; the flow of water from the various streams gauged;

plans and specifications of the works prepared, and cost of the right of way and lands required for reservoirs ascertained.

"That as an increase of population in future years may demand, the line of works can then be extended to utilize the supply from more distant streams on the peninsula, so that the present generation will not be taxed to provide water supply for the next.

"That the city should own the water-works, and have control of the whole water supply.

"That no time should be lost by the city in taking favorable action on this important question of public interest.

"That we recommend the city make application to the State Legislature, now in session, to secure the proper legislation, giving authority (to the city) to provide funds to carry out these measures, which, we believe, are of vital importance to the health and comfort of the people, and necessary to the actual existence of the city itself."

Subsequently said Committee introduced a bill for presentation to the Legislature, for the approval of the Board, providing for the establishment of a system of water-works, which was passed for printing on December 18th, but in consequence of a difference of opinion as to the sources from whence water should be taken, the bill was not finally passed and approved.

No further steps were taken in the matter until the organization of the present Board, when the Special Committee on Amendments to the City Charter, consisting of Supervisors Jas. B. Roberts, Stewart Menzies, and M. Lynch, prepared and presented for the consideration of the Board, on January 19, 1874, a bill to authorize the City and County of San Francisco to provide and maintain public water-works, etc., and on their recommendation due publicity was given by publication of the same.

At the same meeting, on motion of Supervisor Scott, Resolution No. 4,787 was adopted, reciting that there was a growing necessity and anxiety in the community looking to an adequate supply of water for future necessities, and that the city should own and control water-works, and providing for the appointment of a committee of five members to examine into the subject and report to the Board. On February 2, 1874, the Mayor appointed Supervisors Deering, Lynch, Scott, Macdonald, and Ebbets, as a Special Committee on Water Supply, and on that date the committee, by Supervisor Deering, reported back the bill introduced on January 19th, with amendments, which was passed to print, and on the 9th of February the bill was, on the recommendation of the committee, finally passed with Resolution No. 4,837, which requested our delegation to procure its passage by the Legislature.

The bill, as prepared by the Board, was amended in several particulars and passed by the Legislature, receiving the approval of the Governor on the 30th day of March, 1874. The following is the Act referred to.

AN ACT

TO AUTHORIZE THE CITY AND COUNTY OF SAN FRANCISCO TO PROVIDE AND MAINTAIN PUBLIC WATER-WORKS FOR SAID CITY AND COUNTY, AND TO CONDEMN AND PURCHASE PRIVATE PROPERTY FOR THAT PURPOSE.

[Approved March 30, 1874.]

The People of the State of California, represented in Senate and Assembly, do enact as follows:

SECTION 1. The Board of Supervisors of the City and County of San Francisco are hereby authorized and empowered to take all necessary steps to provide and supply said city and county, and the inhabitants thereof, and manufacturing establishments therein, with a sufficient and abundant supply of pure, fresh water, at the lowest possible rates, and to secure an abundant supply for their future wants; and to that end, and for that purpose, they are hereby authorized and empowered to construct, appropriate, and acquire, or to purchase and hold the necessary real estate, water-works, reservoirs, distributing mains, pipes, flumes, ditches, water and water rights, creeks, ponds, springs, and sources of supply pertaining thereto, in this State; and to contract with any person or persons, corporation or corporations, to construct and put in operation the necessary machinery, water-works, reservoirs, aqueducts, ditches, and flumes, and to lay down distributing mains and pipes through the streets of said city and county, for supplying the same, for the above and all other useful purposes, and to do and perform all such acts and make and enter into all such agreements and contracts as may be necessary and proper to carry the objects and purposes of this Act into operation and effect. Nothing in this Act contained shall authorize the appropriation or condemnation of any water or water rights in the counties of Santa Clara, Tulare, or Kern, nor shall anything in this Act contained be so construed as to authorize the condemnation of water already appropriated for mining purposes and necessary therefor.

SEC. 2. Should said Board of Supervisors, after a careful examination, determine that it is expedient and proper, and for the interest of said city and county, and its inhabitants, to acquire for said city and county the water-works, reservoirs, pipes, flumes, ditches, distributing mains, water, water rights, and real estate, owned by the corporation known as the "Spring Valley Water-Works," or by any other corporation or person in this State, or the water of Laguna de la Merced, and the real estate connected therewith, with all the water rights, creeks, springs, and sources of supply pertaining thereto, or any or either, or any part of any or either of them, or any running streams, or other sources of supply of fresh water that can be made available for the use of said city and county, whether the same is owned or claimed by any person or persons, firm, company, corporation or corporations; then and in that case, said Board of Supervisors are authorized and empowered to purchase the same, or so much, and such parts and parcels thereof, as they shall deem advisable and necessary, at and for such price or prices as may be agreed upon between said city and county, represented by a committee consisting of the Mayor, Auditor, and City and County Attorney, acting on its behalf, and the owner or owners, respectively, of the real estate, water, and property so sought to be acquired; but before any contract to purchase shall be entered into by said Board, or by the committee herein named on behalf of the city and county to negotiate a purchase, or before they shall proceed in that behalf, either to purchase any water-works or source of water supply, or to contract for or with any person or corporation for a supply of water for said city and county, or to construct any works for the purpose of supplying said city and county with water from any source whatever, it shall be the duty of said Board of Supervisors to appoint a competent civil engineer, have made the survey hereinafter required and have on file in their office his report, showing all such matters and things as are hereinafter mentioned as necessary to be shown. It shall be the duty

of said engineer, under the direction of said Board of Supervisors, as soon as practicable after his appointment, to make full and accurate examinations and surveys of all real estate, water-works, reservoirs, distributing mains, pipes, ditches, flumes water and water rights, creeks, ponds, springs, and sources of supply of water which it is contemplated to purchase, and prepare and file with his report accurate maps of the same. As soon as he has completed his examinations, surveys, and maps, he shall make a full and complete report in writing to said Board, of the result of his labor, which must show substantially the following matters:

First. A particular description of each piece or parcel of real estate proposed to be purchased and directed to be surveyed.

Second. The alleged amount of daily supply of water and the estimate of daily supply made by said engineer.

Third. The source or sources of water supply and a particular description of the water rights appertaining thereto.

Fourth. The size and capacity of all reservoirs.

Fifth. The length, size, and condition of all flumes, tunnels, pipes, mains, and distributing pipes.

Sixth. An estimate, in detail, of the cost and present value of all said property.

Seventh. An estimate, in detail (as near as may be), of operating said works and maintaining them.

Eighth. A statement of such other matters as said Board of Supervisors may direct, or said engineer may deem proper to present to the public concerning the matter.

The salary of said engineer, and the compensation of his assistants, and all other incidental expenses necessarily connected with the proceedings, shall be fixed, allowed, and ordered paid by said Board of Supervisors, and the same shall be audited, allowed, and paid out of the general fund of said city and county. After the report of said engineer has been filed with said Board of Supervisors, they shall carefully examine and consider the same, and if, after a thorough examination thereof, they are of the opinion that the property described therein, or any part of the same, should be purchased and owned by said city and county, they shall pass a resolution to that effect, designating generally therein the property designed to be purchased, which resolution must be approved by the Mayor before it takes effect. Thereafter the committee representing the said city and county as herein named, shall proceed to view and carefully examine each piece or parcel of real estate, all water-works, reservoirs, flumes, ditches, and sources of water supply, and all other property contemplated by said resolution to be purchased, and after having made such personal examination they shall prepare and report, in writing, to said Board, the result of said examination and their conclusions thereon, based upon their own observations and the surveys and estimates of said engineer, giving in the same manner as said engineer, a full and detailed estimate of said property, and the price at which it can be purchased. Whenever the said last mentioned report has been made and filed, or whenever the award of commissioners shall be made and filed, said Board of Supervisors shall immediately cause the material parts thereof (except maps and surveys) to be published in three daily newspapers published in said city and county for the period of thirty days. On a careful examination of said report, should it meet the approval of said Board, and they deem it for the interest of said city and county to purchase the property described therein, at the price named in said report, they shall submit it to the qualified electors of said city and county, at the next general election to be held thereafter; but should said committee be unable to agree, with the owner or owners of any property sought to be acquired, on a price to be paid therefor, then the price or prices to be paid therefor shall be ascertained and awarded as hereinafter provided; but in case said committee unanimously agree with such owners on such price, said city and county shall not be bound thereby until after their award and appraisement shall have been submitted to a vote of the qualified electors of said city and county as herein provided, and shall have received a majority of said votes at said election.

SEC. 3. In order to procure the condemnation and appropriation of the real estate refer-

red to in the preceding section, or any part or portion thereof, and such other real estate and water rights as may be deemed, by the Board of Supervisors of said city and county, necessary for an additional supply of pure, resh water; and, in order further to ascertain the true value of such real estate, water works, and appurtenances, the Mayor, Auditor and City and County Attorney of said city and county are hereby appointed to represent said city and county as of the one part, and the owner or owners of the real estate and water rights thus sought to be condemned and appropriated to public use, of the other part, shall each have the right to appoint three citizens of this State, who shall be entirely disinterested and unconnected with any one who may be interested in the subject matter, and those appointed to represent said city and county shall also be residents and freeholders of said city and county, and the court of the Twelfth Judicial District in and for said city and county, upon the application and petition of the Mayor, Auditor or City and County Attorney, on behalf of said city and county, or of any of the parties interested in such lands or water sought to be acquired, shall appoint the seventh Commissioner, of like qualifications, and who shall be a resident and freeholder in said city and county, and said Commissioners, so appointed, shall severally take and subscribe an oath that he will perform the duties of such Commissioner without fear, favor, or partiality, and to the best of his ability; he will endeavor to ascertain and report the true value of each and every piece and parcel of property and right of property, sought to be appropriated by these proceedings to the public use, and that he will do equal and exact justice to the whole subject matter committed to him.

SEC. 4. Should the owner or owners of any property sought to be condemned and appropriated to public use, under the provisions of this Act, neglect or refuse, for the period of thirty days, to appoint Commissioners on their behalf, as hereinbefore provided, after having been requested, in writing, by said committee representing the city and county so to do; then and in that case, the Commissioners appointed by said city and county shall proceed and make the appraisement of the property, and report as in other cases. In case of a vacancy or vacancies in the office of any of said Commissioners by death, resignation or otherwise, the same shall be filled in like manner as in the former instance.

SEC. 5. That the said Commissioners shall, immediately after their appointment and qualification, as aforesaid, proceed to view and examine each and every parcel of property, real, personal, and mixed, sought to be condemned and appropriated by the proceedings by which they are appointed, and after viewing and examining the same, they shall appoint a time and place, in said city and county, when and where they shall hear the evidence, and take the proofs of all parties and persons interested, as to the ownership and value of said property. They shall publish, in three daily newspapers in said city and county, notice of the time and place of such meeting, with a brief description of the property sought to be acquired, for ten days prior to the same; and, after the publication as aforesaid, said Commissioners shall have jurisdiction to hear and determine, as hereinafter provided. The Commissioners may then commence to take evidence and proofs, and may continue the same from day to day, until each and every party to said proceedings have had an opportunity of producing such testimony as the parties in interest may deem necessary to establish the value of said property; and said Commissioners are empowered to employ counsel to aid them in conducting the proceedings, and also to employ a short-hand reporter to take the testimony in short-hand, and transcribe the same into long-hand. The Commissioners are hereby authorized to administer oaths to each and every witness brought before them, and to issue subpœnas for witnesses; and any person, on being subpœned to attend before them as a witness, and failing so to do, may be punished by said court for contempt. Said Commissioners shall, within six months subsequent to their appointment and qualification, file with the County Clerk of said city and county, their report, which shall contain a description of all the real estate, property, water, water-works, and all appurtenances sought to be appropriated to public use by such proceedings; and also the amount that, in the judgment of the Commissioners, should be paid by said city and county of San Francisco to the owner, or several owners, of the said property, as their just compensation therefor. The report shall also name the owner and owners of the property described in the report, together with a statement of the interest of each therein, so far as the same can be ascertained from the

Recorder's office of the county in which the property shall be situated; and if there is any lien or mortgage upon any of the said property, the amount of the same, and to whom payable.

SEC. 6. The report shall be agreed and subscribed to by at least five members of the seven comprising said Commission. Not less than two of such five shall be of those appointed on behalf of the city and county, except when said Commission consists of three members as hereinbefore provided, and in that case it shall be agreed and subscribed to by a majority of them. They shall transmit with their report a copy of all the evidence and proofs taken by them in the course of the discharge of their duties as Commissioners, and file the same with said County Clerk. Upon the filing of the report the Clerk of said County shall cause a notice of the filing of the same to be published for ten days, daily, in three daily newspapers published in said city and county; and within twenty days after the first publication of such notice, any party or parties interested, or any tax-payer of the said city and county, may file his or their objections, in writing, against the confirmation of the report of said Commissioners; and if, at the expiration of said twenty days, no objections are filed, the Judge of the Twelfth District Court shall, in his discretion, make and enter an order confirming said report; but if such objections are filed, the said District Court shall appoint a day for the hearing of the same, and upon the day designated, or other day or days to which the hearing of the same may be adjourned, the said court shall proceed to hear the allegations and proofs of the respective parties, and may confirm, reject or modify the report of said Commissioners, in whole or in part, as to all the property sought to be condemned, or as to any part thereof, or refer the same back, in whole or in part, to the said Commissioners, for further action, who shall report upon the matters which said Commissioners are required to report upon, in pursuance of instructions to be given by said court; and the report of five of said Commissioners as hereinbefore provided in one case, and a majority of the three in the other as to the lands, waters, water-rights and right of way sought to be condemned and as to the price to be paid therefor when the same is confirmed by said District Court, shall be final and conclusive, and binding upon said city and county, and the owners of the property (unless set aside for actual fraud); *provided*, that the said report and appraisement shall be submitted to a vote of the qualified electors of the said city and county, at the next general election to be held thereafter. At said election the question to be voted for shall be: "Shall said report and appraisement be adopted?" and if a majority of the votes cast are in favor of said report and appraisement, then the said city and county shall take and pay for said property, as by said award and report determined. But in case a majority of said votes are against said report, appraisement, and award, then said city and county shall pay all the expenses of said Commission approved and allowed in the premises; and the city shall not take or pay for such property, and from thenceforth said Commission shall be terminated and discharged, and said city and county be relieved from all further obligation or liability in the matter or proceeding. The Board of Supervisors shall make all necessary provision and regulation for the election herein provided, which shall be conducted and governed by the General Election Laws of this State, so far as the same are applicable thereto.

SEC. 7. In the order of the said court, confirming the report of said Commissioners, the said court shall, so far as practicable, order and decree to whom the compensation awarded for any piece or parcel of the real estate, water and water-rights described in the report, shall be paid; and when the same is directed to be paid to more than one person, the said order shall state the amount to which each is entitled; and the said order shall direct that upon the payment of the several sums awarded as compensation for the property so sought to be appropriated to public use by said city and county, a good and sufficient deed of bargain and sale as to which or for which said compensation has been awarded, must be signed, sealed, and delivered by the owner and owners of said real property; and in case of neglect or refusal to execute said deed, the said District Court may appoint a Commissioner, with full power to convey to said city and county of San Francisco all right, title, and interest which said owner and owners and claimants may have in said real estate, property, water, water rights, and appurtenances; and the said District Court may direct the proper sheriff to place said city and county of San Francisco in the possession of the property as to which

payment has been made or tendered; and as soon thereafter as practicable, the Board of Supervisors of said city and county may employ a competent and skillful engineer or engineers, under whose supervision and direction the said Board of Supervisors may at once commence to erect works, reservoirs, flumes, distributing pipes, and all things necessary for distributing an additional supply of pure, fresh water to the inhabitants of said city and county of San Francisco, from any of the sources of supply appropriated to the public use by these proceedings.

SEC. 8. The Commissioners appointed under and by virtue of this Act shall not be entitled to any compensation for their services, but shall be allowed the actual expense incurred under the provisions of this Act, but not to exceed the sum of ten thousand dollars, the amount to be settled and certified to by said District Court, and to be taxed by said court as a part of the expenses of the proceedings, and to be paid by said city and county.

SEC. 9. In order to raise means necessary to carry into effect the provisions of this Act, the Board of Supervisors of said city and county shall be, and they are hereby fully authorized to issue bonds of the said city and county of San Francisco, as hereinafter provided.

SEC. 10. Said bonds shall be issued in sums of one thousand dollars each, and shall draw interest at the rate of six per cent per annum from the date thereof; and the principal thereof shall be made payable at a specified day, to be named in said bonds, which shall be thirty years after their date, at the office of the Treasurer of said city and county, both principal and interest to be payable only in gold coin of the United States. The interest accruing on said bonds shall be due and payable semi-annually, on the first day of January and the first day of July of each year, at said Treasurer's office. Said bonds shall be signed by the Mayor and Auditor of said city and county, and registered in numerical order, in books to be kept for that purpose, by the Mayor, the Auditor, and the Treasurer of said city and county, respectively; and, when so signed, shall be presented by the Mayor to the Clerk of the Board of Supervisors of said city and county, who shall, in the presence of the Mayor, countersign the same as such Clerk, impress the corporate seal on each, and redeliver them to the Mayor, who shall thereupon report to said Board of Supervisors, at a meeting thereof, the number, date, and amount of each bond so signed and countersigned, which report shall be entered upon the journals of said Board. Said bonds shall only be issued or disposed of in the order in which the same shall be numbered. Said bonds, or any portion thereof, may, on a vote of a majority of the Board of Supervisors and approval of the Mayor, be sold, at not less than par, from time to time, as said bonds shall be required to pay for the property purchased, and to extend, repair, and improve the water-works hereby contemplated. The total of such bonds to be issued, shall be fixed by the Board of Supervisors of said city and county.

SEC. 11. The Board of Supervisors of said city and county shall, by order, from time to time, fix the rates to be paid by consumers of water, which rates shall never exceed an amount sufficient to pay interest on said cost of acquiring the real estate, water, and water rights hereby authorized to be acquired, at the rate of six per cent. per annum, and interest on the cost of laying down mains and building reservoirs, and also the actual annual cost of keeping the same in repair, and the actual cost of managing said works, and the Sinking Fund in this Act mentioned; *provided*, that such Sinking Fund shall not be created until ten years after the issuance of the first of said bonds.

SEC. 12. Coupons for the interest shall be attached to each bond, so that the coupon may be removed without mutilation of the bond; and said coupons shall be signed by the Treasurer of said city and county. When any interest shall be paid on any bond issued under the provisions of this Act, the said Treasurer of said city and county shall detach the coupons for the interest then due and paid, and cancel and deliver the same to the Auditor, taking his receipt therefor; and it shall be the duty of the Auditor to file the same in his office, and to make a report thereof at the next meeting of the Board of Supervisors.

SEC. 13. It shall be the duty of the Board of Supervisors of said city and county, prior to the making up of the general assessment roll for said city and county, to levy each year at the time of levying other municipal taxes, a tax, to be styled "The Water-works Tax," sufficient to raise any deficiency for interest required to be paid each year upon said bonds,

and the Sinking Fund hereinafter mentioned, after applying the net proceeds or income from water rates thereto; but no tax for said Sinking Fund shall be levied until after ten years from the time of issuance of the first of said bonds. Said tax shall be levied and collected in the same manner as the general taxes for city and county purposes, and when collected, shall be paid to the Treasurer of said city and county, and shall form a part of the Water-works Fund, and the money in said fund shall be applied by said Treasurer to the purposes of this Act:

First—To the payment of the interest on said bonds, as the same shall fall due.

Second—To the redemption of said bonds, as hereinafter provided. Said bonds shall, until paid, be a lien upon all real estate, water, water rights, and property, acquired under the provisions of this Act.

SEC. 14. It shall be the duty of the Treasurer to pay the interest on said bonds, out of the money in the Water-works Fund, when due; and whenever at any time there shall be in said Water-works Fund a sum of money amounting to twenty thousand dollars, or upwards, over and above what shall be required for the payment of the interest for the then fiscal year, the said Treasurer shall advertise, for two weeks, in two daily newspapers published in said city and county, for sealed proposals for the redemption of said bonds; and ten days after the expiration of the time of such publication, he shall, in the presence of the Mayor and Auditor aforesaid, open such sealed proposals, and shall pay and liquidate, so far as the money on hand and applicable thereto shall extend, such bonds so presented under said proposals, as shall have been offered at the lowest price or prices: *provided*, the same shall not be for more than par value thereof. And, whenever any of the said bonds shall have been paid by said Treasurer, he shall mark the same "Canceled," over his own signature, and note such cancellation upon the register of such bonds kept in his office, and immediately deliver the same to the Auditor of said city and county, taking his receipt therefor; and the said Auditor, on receiving such canceled bonds shall file them in his office, and also note such cancellation upon the register of such bonds kept in his office. The Treasurer shall continue to comply with the requirements of this Act, until all the bonds and coupons issued for the objects and purposes herein mentioned shall be paid and liquidated in full.

SEC. 15. The Mayor of said city and county shall have power to appoint three Commissioners, without salary, for the term of four years, subject to the approval of the Board of Supervisors, who shall have full and complete management and control of all the real estate, water, and waterworks, provided for and acquired under this Act, who may appoint competent and reliable persons to supervise and manage the same, to the best possible advantage to the inhabitants of the City and County of San Francisco, and may fix the salary and term of office of such employees, under such orders and resolutions as the Board of Supervisors of said city and county may from time to time adopt.

SEC. 16. The Board of Supervisors of said city and county may, by ordinance, pass such rules and regulations as may be proper, in the judgment thereof, to provide for the collection of water rates and water dues; to cut off the supply of water from consumers who shall make default in the payment thereof; to prevent any interference with the mains, reservoirs, sources of supply, and pipes of the waterworks; to prevent any impure, deleterious, or foul material from being thrown or dumped in any watercourse or water supply connected with such waterworks, or the conduct of any business, art, or trade, which, by drainage, may injuriously affect the water supply.

SEC. 17. Said City and County of San Francisco shall not be permitted to take possession, unless with consent of the owner or owners, of any real estate, water, or water rights, hereby authorized to be acquired, until the compensation agreed upon or determined, as hereinbefore provided, shall have been paid either to the person, persons, or corporations determined to be entitled thereto, or deposited with the Treasurer of said city and county of San Francisco, who shall hold the same subject to an order of the Judge of the Twelfth Judicial District Court to pay the amount so deposited to the party or parties entitled thereto.

SEC. 18. Said city and county is authorized to lay down and maintain mains, or water pipes, in the streets and highways of said city and county, and also in any county or counties of this State.

SEC. 19. This Act shall take effect on and after its passage.

On the 13th of April, 1874, the Board, on motion of Supervisor Ebbets, adopted a Resolution (No. 5,024) requesting the Mayor to appoint a special committee of five members to consider and recommend such action to be taken by the Board, on the future supply of water for use of the inhabitants of the city and county, as contemplated by the provisions of the aforesaid Act of the Legislature, in order to furnish a sufficient and abundant supply of pure, fresh water. On the twentieth day of the same month, Supervisors Deering, Lynch, Scott, Macdonald, and Ebbetts, were appointed, and thereafter proceeded personally to view and examine the various sources of water supply, visiting for that purpose the Blue Lakes, Clear Lake, the Calaveras Valley and water sources, the Spring Valley Water-Works and sources, the waters of the Laguna de la Merced, and all the other sources and water sheds on the peninsula. On the 3d day of August, 1874, T. R. Scowden, Esq., was elected by the Board as Chief Engineer of the Water Supply, for which position he was reputed peculiarly fitted from his ability and experience in the successful construction of water-works in the East, and other engineering works of magnitude.

In view of the criticism on the proceedings attending the surveys and reports made, the reply of T. R. Scowden, Esq., accepting the position of engineer, is herewith presented:

SAN FRANCISCO, August 24, 1874.

To the Honorable the Board of Supervisors of the City and County of San Francisco:

GENTLEMEN—Permit me to acknowledge the honor that you conferred upon me on the 3d inst., by electing me to the office of Engineer, to make the required examinations, surveys, and report in the matter of providing an ample supply of pure fresh water for the city and county of San Francisco, which office I hereby thankfully accept.

In accepting this highly important and responsible trust, I recognize the evidence of your confidence and expectations, which I highly appreciate and will try to fulfill.

With regard to the various schemes of water supply proposed, to which your own and public attention has been called, I have formed no opinions or prejudices, I have no preference for places nor persons interested in them. My duty as Engineer is a plain one; besides, my election to an office unsought, places me in an attitude before your Honorable Body wholly free to serve the city alone to the best of my experience and ability. I am unpledged to any party or interest whatever.

In the selection of sources and sites designated for works, it is clear that but one of the many proposed can be adopted. Hence the plan or system of water supply which, after careful examination, surveys and comparison, I may find combines the advantages of an abundant and uninterrupted supply of pure and wholesome water, with simplicity of construction and economy of cost, and which, when finished and put in operation, can be at the least trouble and expense maintained in good action and repair, will be recommended by me.

An enterprise of such magnitude and importance as the one in contemplation, involving as it does an outlay of millions in its accomplishment, as well as the comfort, cleanliness and health of the citizens, intended also to protect the property and lives of the inhabitants from fire and promote the growth and general prosperity of the city, commends itself not only to your attention, but to the property-owners, tax-payers and whole community.

From these considerations I have no doubt that your Board will adopt the very best of all he plans submitted and reported upon to supply the city and county of San Francisco with water.

In entering upon my duties which I am prepared under your instructions to commence, I do not expect to inspire confidence by promises. I only expect to do so by performances. But I may be pardoned for assuring you that my whole thought and skill will be centered in my work. During its progress I feel that I shall need your good counsels and support. Thus sustained, I confidently expect to discharge the duties of my office faithfully and with impartiality to all.

Respectfully, your obedient servant,

T. R. SCOWDEN.

On the 24th of August, 1874, on motion of Supervisor Deering, the following Resolution (No. 6,298) was adopted:

Resolved, That the Engineer, in the matter of providing water-works and water supply for this city and county, be and he is hereby directed to procced with such assistance and equipments as he may deem necessary, to examine the following designated sources of water supply, any one or more of which may be hereafter deemed proper to acquire for the use of this city and county, to wit: Blue Lakes, Clear Lake, the Calaveras Valley and its water sheds and sources, Lake de la Merced, the Spring Valley Water Works and sources, and Pescadero Creek. Also to institute such measurements or gaugings and to procure such samples of water from the different sources during the present dry season as to determine the minimum supply and the quality of the water furnished by each; also to make the required surveys and estimates, accompanied by such plans, plats, maps and descriptions as to clearly define the character, capacity and cost of works to connect with each source and deliver at the city an ample supply, to meet the present and future demands of said city, and to submit a full and complete report upon the same to this Board at the earliest period practicable.

Supervisors Pease, Kenney, Ebbets, Sims, Deering, Block, Scott, Hewston, Lynch, and Macdonald voting for, and Supervisor Menzies against, the passage of the resolution, Supervisor Roberts absent, Supervisor Menzies changing his vote for the purpose of moving a reconsideration of the vote whereby the resolution was passed, which motion was made at the next meeting and lost, Supervisors Menzies, Kenney, Roberts, and Hewston voting for, and Supervisors Sims, Deering, Block, Scott, Lynch, and Macdonald against, the reconsideration, Supervisors Pease and Ebbets absent.

This action was followed by Resolution No. 6,342, introduced by Supervisor Deering, which was finally passed on August 31st, to-wit:

Resolved, That it is expedient and proper and for the interest of the city and county of San Francisco and its inhabitants, to acquire for said city and county, the water, water rights, real estate, reservoirs, ditches, flumes, pipes, distributing mains, and water-works of the Clear Lake Water Company, of the Blue Lakes, of the Calaveras Valley Water Company, of the San Francisco Water Company, of the Spring Valley Water Company, and the water of Laguna de la Merced, either or all, and the real estate connected therewith, with all the water rights, creeks, springs, and sources of supply pertaining thereto, or any or either, or any part of any or either of them.

Supervisors Pease, Kenney, Sims, Deering, Roberts, Block, Scott, Lynch, and Macdonald voting for, and Supervisors Menzies and Hewston against its passage, Supervisor Ebbets absent.

On September 7, 1874, the Board, by Resolution No. 6,371, fixed the salary of the chief engineer at $750 per month, the first assistant engineer at $250 per month, the assistant engineers at $150 each per month, and rodmen and chainmen and other employees at $75 each per month, Supervisor Menzies voting against the passage of the resolution.

On October 12, 1874, a further Resolution No. (6,550) was passed, directing the engineer to proceed to, and make surveys of Clear Lake and the route to this city, and report thereon to the Board.

In order that no delay might be had to prevent the people from considering and passing upon the merits of the various projects, the engineer, T. R. Scowden, Esq., prepared and filed the following report prior to the completion of the mapping out of the various surveys, which report was presented by Supervisor Deering and received on the 19th day of April, 1875, and referred to the Special Committee on Water Supply.

REPORT OF ENGINEER.

To the Honorable the Mayor and Board of Supervisors
of the City and County of San Francisco:

GENTLEMEN—For the purpose of providing an unfailing and plentiful supply of pure, fresh water for the City and County of San Francisco, the sources, water-sheds, and streams connected with the Blue Lakes, Clear Lake, Lake Merced, the Valley of the Calaveras, the Spring Valley Water-Works, and Pescadero Creek, have been explored and surveyed in accordance with your instructions.

The cost of works adapted to the necessities of each case has been carefully estimated; also the cost of a receiving reservoir, located within the city limits, and the cost of a complete system of pipes for distributing the water throughout the streets and alleys of the whole city, as shown on the official plat of San Francisco.

I recognize the magnitude and importance of the duties that fell to my lot when your honorable Board appointed me to the post of Chief Engineer of Water Supply. Your confidence in my ability to fulfill the obligations imposed by the acceptance of the office, has been constantly manifested by an entire absence of interference in any course I have seen fit to adopt within your general directions. No member of your Board has sought to delay or hasten my labors, nor to warp them into any channels inconsistent with the public good. I acknowledge, therefore, that the responsibility rests upon me alone for all the plans of water supply for the City and County of San Francisco, that may be presented to your Board by your appointee. I seek this occasion to make emphatic mention of the faithful and valuable services, rendered by my first assistant, G. F. Allardt, and the efficient corps of engineers,

who have been with me both in the field and in the office. It gives me pleasure to acknowledge their ability, energy and fidelity.

To arrive at the character, capacity, cost, and relative merits of the different schemes presented, I desire to state that each plan has been carefully studied and that the facts stated, and the figures herein contained will go far in aid of just conclusions. That plan in which rest the essential elements of simplicity, thorough efficiency, and economy of cost and maintenance, is herein unhesitatingly recommended to your honorable Board for selection and adoption.

On Friday, the 5th of September last, a corps of engineers, with Assistant Allardt and myself, left the city for the Sierra, and upon our arrival commenced the reconnoissance and surveys connected with the Blue Lakes water scheme. Since then the reconnoissance and surveys of the Clear Lake, Lake Merced, Calaveras, Spring Valley, and Pescadero water schemes have been made, together with the computation, mapping, and plotting, not only of the general plans, but of the details connected with each, such as reservoirs, canals, tunnels, flumes, and pipe lines for delivery at, and distribution of water through the city, with estimates of cost and reports upon the same.

One of the lines of survey is nearly two hundred and twenty miles in length. There has been but little more than an average month of time consumed in the investigation and survey of each of these six schemes, and when it is considered that to study and mature, as well as to project the plans, mostly on an extensive and necessarily costly scale (excepting the Spring Valley Water-Works, which are built and in operation); it will be seen that the efforts of parties in the field and in the office have been severe and constant. All the valuable and important interests above designated are competing ones, but one only of the number has been recommended by me for your adoption. These interests are so conflicting that no engineer can reconcile them, however able or astute he may be; still, as stated in my letter of acceptance of the office I now hold, whatever complaints may be made concerning, or faults found with what I have attempted to do, I shall rest content with having discharged my duty faithfully and with impartiality toward all.

So much has been said with regard to natural reservoirs or lakes, as contrasted with artificial ones, on account of the supposed liability to accident, from the breaking away of the dams or retaining embankments, either of stone or earth, that it is thought proper here to remark, that none of the proposed schemes would be without lakes or reservoirs enclosed partly or in whole by dams. The water so walled in is supplied, in every case, from the same source, namely, the clouds, and falling in the form of rain or snow on the contiguous water-shed is collected and stored in lakes and reservoirs. No method has been proposed, nor is it even considered practicable, with our present light on civil engineering, to build water-works without dams to retain the water collected and stored in the reservoirs, whether supplied from pumps or water-sheds. In this respect all water schemes are subject to similar objections, and liable to the same contingency of accident. Substantial work, faithfully constructed, is the only remedy—the only safeguard. Works of this

character throughout are made the subject of this report, and for which estimates of cost are rendered.

Respecting the quality of water from the different sources proposed, infiltration by seepage or percolation through sand, gravel, or rocky formations, clarifies, but does not purify water, except so far as it is vitiated by matter held in suspension, but does not remove any impurities held in chemical combination. Hence the idea that water contained in a natural reservoir possesses superior qualities to that contained in an artificial one, is not supported by the well known facts of the case. It may be gratifying, however, to the citizens to learn that the quality of the water from any of the proposed sources of supply, as determined by chemical analysis, is in no way impaired by impurities; these analyses, together with the chemist's certificates, may be found annexed to this report.

For the present and the coming ten years, the quantity of water contemplated to be delivered to the City and County of San Francisco, having a prospective population of 500,000, is 100 gallons per diem to each inhabitant, or 50,000,000 gallons in every 24 hours; for the second decade a supply at the same rate, for a population of one million, another plan is provided and recomended near the conclusion of this report. The Croton aqueduct brings to each inhabitant of New York City 80 gallons per diem, and it is a city considered to be amply supplied with water. By the plan herein contemplated for San Francisco, each of its inhabitants will have 100 gallons per diem, it being necessary to make provision for a more abundant supply, because of the absence of rain-fall during nearly six months of the year. In New York, during the summer months especially, heavy thunder showers prevail, which serve to wash to absolute cleanliness its streets and alleys, to flush the sewers, and irrigate its parks, gardens, and public grounds. These benefits the citizens of San Francisco can enjoy every day throughout the year, by the use of the surplus amount of water provided for them over that furnished in New York.

The canals, tunnels and flumes for each system of supply are estimated for, to convey 100,000,000 gallons every twenty-four hours. But at the start the syphons and one pipe line (there being two contemplated), extending from the end of the canal to the distributing reservoir in the city, will be of a size sufficient to deliver 50,000,000 gallons every twenty-four hours. Suitable attachments are provided at the terminus of the canal, and at the reservoirs to connect the second pipe line, when necessity requires. Your careful consideration is especially directed to the important matter of water rights in examining the question of cost as exhibited by the engineer's estimate, in which the price of water rights does not appear; it being withheld by the parties interested, to be settled by negotiation with the city *after* some one of the plans recommended is adopted.

It will be observed that all the work, material and labor, used in the construction of the contemplated work, are estimated and measured by the same standard. For example: one price has been established for each item or

article running through all the estimates of cost classified as follows, namely: reservoir embankments or dams, earth excavations, masonry, lumber, labor, tunnels, flumes, iron pipe, etc. The thickness and weight of iron pipe is proportioned to the head of water or pressure sustained, and the diameter due to the delivery of a given volume of water, time and distance being considered. In like manner a standard has been adopted for measurement and utilization of snow and rainfall, collected from watershed and stored in lakes or reservoirs, estimated at 50 per centum of that indicated by rain gauge measurement. In establishing this co-efficient of 50 per cent. for the effective utilization, the loss of eight inches per month from the surface of the water stored, due to evaporation and absorption, has not been considered.

Although the prices fixed for material and work are approximate, not absolute, and may vary in different places, from convenience to market, it became necessary to establish a uniform basis for calculation that would work no injury, but operate equitably and impartially, as a standard for comparing the cost and economy of the different works proposed, and this is the one adopted. It is worthy of notice that dams of stone or earth built to retain water stored in reservoirs are frequently condemned from fear of accident, but it was not deemed expedient even by the parties in interest to use even lakes, or so called natural sources, without dams to increase their depth and storage capacity, thus exhibiting a confidence in dams. The prejudice against dams for water works purposes, arises from their supposed insecurity, or liability to break, and thus interrupt the supply of water to the city; but in the construction of the works in view, security must be guaranteed by the use of good material and the requirement of skillful and faithful workmanship, without which all construction fails.

The principal advantage which large lakes, such as Clear Lake or Lake Tahoe, gains over an artificial reservoir, consists chiefly, if not wholly, in their storage capacity, to carry a supply of water over consecutive seasons of dryness. But in that particular, all the water schemes proposed are provided with storage capacity sufficient to meet the contingency of dry seasons. Even the lakes require dams, for Clear Lake has been known to fall eighteen inches below its outlet into Cache Creek; the Blue Lakes also, have been known to fall below their outlets. These two last statements are very sufficient arguments in favor of dams, both for lakes and reservoirs, to retain their surplus water, and thus render the lakes and their sources inexhaustible.

The Spring Valley Water Works for many years in operation and supplying the city with water, have, and the Calaveras and Pescadero are intended to have, reservoirs formed by strong dams, built across their respective streams and valleys, for the storage of rainfall collected from the adjacent watershed. Hence all these sources, whether formed by art or nature, are nevertheless, reservoirs formed in part or in whole by the use of dams, and are subject more or less, to the same contingencies. Lakes are natural reservoirs supplied from their contiguous watersheds, as are also artificial reservoirs connected with gravitation works.

CITY WATER SUPPLY

MAP

OF

BLUE LAKES RESERVOIRS

From Surveys made under the direction of the

BOARD OF SUPERVISORS

OF THE

CITY AND COUNTY OF SAN FRANCISCO

by

T. R. SCOWDEN,

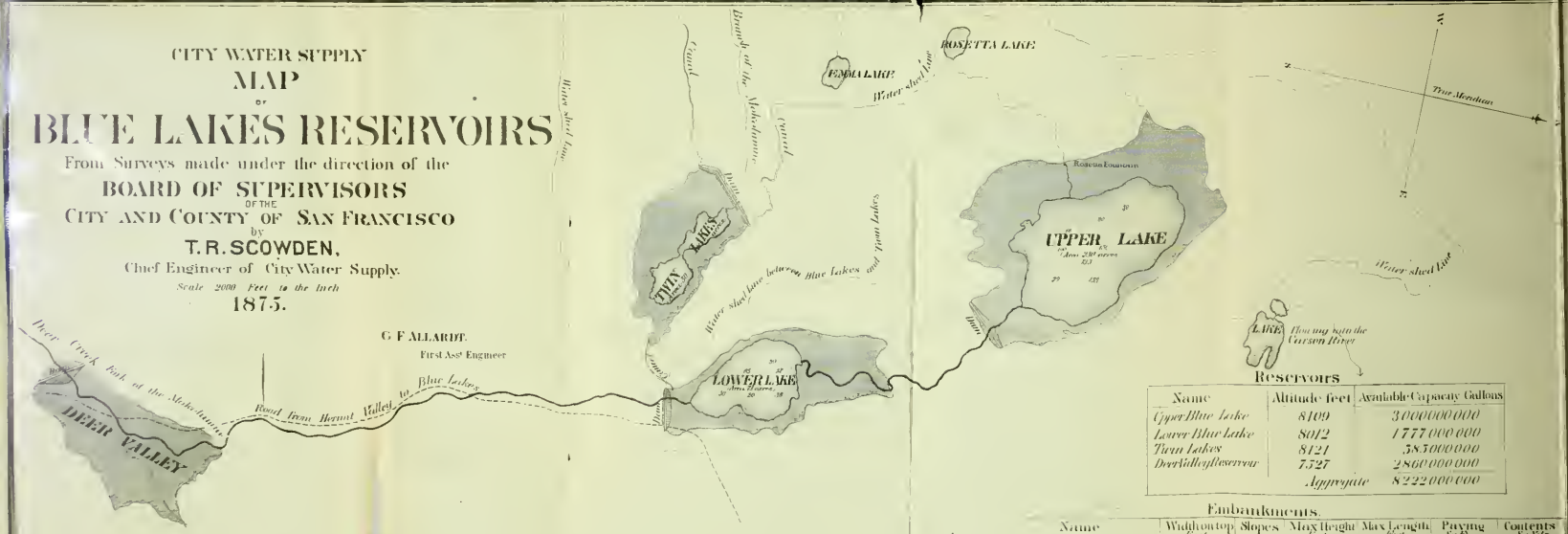
Chief Engineer of City Water Supply.

Scale 2000 Feet to the Inch

1875.

G. F. ALLARDT.

First Ass't Engineer



Reservoirs

Name	Altitude feet	Available Capacity Gallons
Upper Blue Lake	8109	3000000000
Lower Blue Lake	8012	1777000000
Twin Lakes	8121	385000000
Deer Valley Reservoir	7527	2860000000
	Aggregate	8222000000

Embankments.

Name	Width on top Feet	Slopes	Max height Feet	Max Length Feet	Paving Sq Ft	Contents Sq Yds
Upper Blue Lake	40	1 in 3	42	1944	74000	116400
Lower Blue Lake	50	1 in 3	49	1003	80500	132400
Twin Lakes Lower Dam	20	1 in 3	26	1488	76200	54600
Twin Lakes Upper Dam	20	1 in 3	9	416		3900
Deer Valley Reservoir	50	1 in 3	102	1180	172800	471300

Geo. H. Baker, Engineer & Lithographer, 104 Montgomery St. S. F.

If there exists a prejudice against using water from the artificial lake, a like prejudice should obtain against using water supplied by a natural lake. All things being equal, your engineer firmly believes that the water derived from one is just as good, just as pure, and just as healthful as that derived from the other.

All the plans proposed are to be gravitation works excepting that of Lake Merced, where pumping works are required—here the estimate is made for machinery with the latest improvements in all its appointments, to compare favorably in efficiency and economy with the best.

The Blue Lakes, Clear Lake, and Calaveras water supply will flow into the high service reservoir, hereafter described; Pescadero, the Spring Valley and Lake Merced supply into the low service reservoir.

The present charge for delivering water in the city to consumers may be considered high. In order that the water rate may be reduced so that the consumer may have it at as low a price as it is delivered in our Eastern cities, and that he may be certain that his outlay is only a fair first cost for this great necessity of life, it seems essential that the city should own and control the works of supply.

The estimates of cost to build new works are based upon the current rates for material and labor, which vary according to supply and demand. The prospective rise in the price of iron, which figures largely, may, and probably will, during the next twelve months, enhance the estimated cost of some of those schemes very considerably.

It should be borne in mind in reading the following, that the elevation of any water source, or surface of any lake or reservoir, refers to the official base of levels at San Francisco, which is about six feet above high tide.

BLUE LAKES.

The Blue Lakes, three in number, are centrally situated in Alpine county, Cal., on the summit of the Sierra Nevada Mountains. The first has an altitude of eight thousand one hundred and nine feet above city base, and an available capacity of 3,000,000,000 gallons. The second, distant one and a half miles southerly from the first, has an altitude of eight thousand and twelve feet and an available capacity of 1,777,000,000 gallons. The third, distant three-quarters of a mile westerly from the second, has an altitude of eight thousand one hundred and twenty-one feet and an available capacity of 585,000,000 gallons. The first and third of these lakes discharge their contents by connecting canals into the second or lowest one; from the latter the water flows through a natural channel for a distance of three and a half miles to Deer Valley reservoir, altitude 7,527 feet, with a capacity of 2,860,000,000 gallons.

The supply to these bodies of water is derived from a great portion of a

catchment area, varying in width from one to five miles and extending in a southerly direction some forty miles, of a granite formation, and admirably suited to the purposes of water supply. The surplus from the catchment area, after filling the lakes and Deer Valley reservoir, would be discharged into Deer Creek, and flow two and a quarter miles to its junction with Highland Creek, the outlet of Hermit Valley, a point suitable for a reservoir 50 feet deep, with an area of one hundred and fifty acres, and would then flow down the natural channel of the north fork of the Mokelumne, for a distance of thirty-one and three-quarter miles, through an immense cañon or chasm of solid granite, one thousand to fifteen hundred feet deep, the walls sometimes nearly vertical, while the bed of the stream in many places is not more than twenty feet wide, to a dam thrown across the river at an elevation of 2,880 feet above base, where the water is directed to a canal. By the accession of the following streams, viz.: Summit City Fork, Gold Run, Otter Creek, Grizzly Run and Bear River on the north, and Snow Creek and Moon Creek on the south, the Mokelumne is swollen into a mountain river at the dam.

The dividing ridge of the Sierra, the summit of which is sixty feet above, and adjacent to the lakes, sheds the water in an easterly direction into the Carson River, and westerly into the Mokelumne, which is the outlet of the Blue Lakes.

The melting snow, varying in depth from five to twenty feet, portions of which never wholly disappear, and the copious springs and streams on the water-shed, furnish a continual supply of water, which, from its altitude, the geological conformation of the country, being sparsely wooded and limited in soil and vegetation, beyond the possibility of agriculture or manufacturing operations, and far above the mineral belt, must remain forever pure.

The canal which receives its water from the Mokelumne River at the aforesaid dam, thirty-nine miles below the Blue Lakes, extends for a short distance along the southerly bank of the river to the mouth of Blue Creek, a tributary which furnishes water from nearly fifty square miles of catchment area.

From Blue Creek the canal extends along a ridge to the middle fork of the Mokelumne River, thence through a country which partakes of the character usually met along mountain streams, a portion of which is solid granite, generally broken and rough; from the middle fork of the Mokelumne River the canal extends through a tunnel sixteen hundred feet in length, then drops its waters with a fall of three hundred feet, into the Licking Fork of the Mokelumne, thence along the natural channel of the same to a point where the waters are again directed into a canal. This canal extends to Rich Gulch, where a storage reservoir would be located at an altitude of 2,063 feet, and of 175,000,000 gallons capacity. At an intermediate point a branch of the canal taps the south fork of the Mokelumne, which, with all its branches, contributes largely to the main supply.

The water-shed source and supply of the Blue Lakes and the Mokelumne, comprising an area of four hundred square miles, end at Rich Gulch. From here the canal runs along a sloping country to the terminal or Butte Valley

reservoir, a distance of seventeen and seven-eighths miles, thence three miles to the terminus, and there, at an elevation of 1,206 feet, connects with the pipe-line or conduit. The single pipe-line would have a capacity of 50,000,000 gallons daily, to meet the city's requirements for the present decade.

Attachments would be provided at the end of the canal to connect another pipe, of the same carrying capacity as the first, when the demands of an increased population require a further supply. The grade of the canal, from its beginning at the dam to the conduit, a distance of 51¾ miles, will be 6.40 feet per mile, and its carrying capacity 125,000,000 gallons per 24 hours. The minimum supply from all the sources at and below the dam, in the months of September, October, and November, 1874, as observed and measured by the engineers in the field, was found to be 32,237,000 gallons daily.

The Blue Lakes and reservoirs, located along the line of the work, having an aggregate capacity of 8,969,000,000 gallons, will be held in reserve, and only drawn upon during the dry season, when the various sources and streams run low, which occurs every year during a term of about four months; after that period, and until the first of April following, rains prevail, and the streams and tributaries of the Mokelumne are flooded with water, so that the main river supplies a quantity greatly in excess of the maximum daily supply of 100,000,000 gallons.

At every point along the line of the canal, and in proximity to the reservoirs (which will be inclosed by substantial fences) slope ditches or drains built of stone will be provided to carry off the washings from the wagon roads, cattle trails, and the general drainage. The earthy portion of the canal will be paved with stone, no wood or perishable material to be used in the construction of the work. During the winter months the supply would be drawn from the Mokelumne River, at and below the dam, as the lakes and reservoirs in the summit of the Sierra would be frozen and inaccessible.

The conduit mentioned, of 60 and 66 inches diameter and 126⅛ miles in length, would extend from the end of the canal down the slopes of the foothills into the plains, passing under the San Joaquin River, near Johnson's Ferry, thence across Livermore Pass and through Livermore Valley, and under San Francisco Bay near Ravenswood, thence along the westerly side of the bay to the City of San Francisco, and there deliver the supply at the high service reservoir for distribution. A branch from the conduit at Livermore Pass would connect with an additional storage reservoir of 738 feet altitude and 230,000,000 gallons capacity.

The usual attachments, such as water-gates for turning off and on the water when occasion requires, will, at intervals, be provided, on this extended line of pipe. These, and all other details connected with the reservoir and work, though omitted here, are embraced in the following estimate of cost, the object of the parties in interest being to preserve an uninterrupted and pure supply of water, and desiring the whole work to be of an unexceptionable and enduring character:

RECAPITULATION.

Total distance from upper Blue Lake to reservoir in city	217.06 miles
Comprising natural channels	42.00 miles
" canals	46.28 miles
" 9 tunnels	1.02 miles
" 6 syphons, (inverts)	1.64 miles
" conduit	126.12 miles
	217.06 miles

Of the conduit 6,433 feet would be submerged under the Bay of San Francisco, near Ravenswood.

BLUE LAKES—ESTIMATES OF COST.

RESERVOIRS.

116,400	Cubic yards embankment, Upper Blue Lake, at 40 cts	$46,560	
74,000	Square feet paving on embankment, Upper Blue Lake, at 10 cts	7,400	
132,400	Cubic yards embankment, Lower Blue Lake, at 40 cts	52,960	
80,500	Square feet paving on embankment, Lower Blue Lake, at 10 cts	8,050	
58,500	Cubic yards embankment, Twin Lakes, at 40 cts	23,400	
76,200	Square feet paving on embankment, Twin Lakes, at 10 cts	7,620	
471,300	Cubic yards embankment, Deer Valley, at 40 cts	188,520	
172,800	Square feet paving on embankment, Deer Valley, at 10 cts	17,280	
120,000	Cubic yards embankment, Rich Gulch, at 40 cts	48,000	
84,000	Square feet paving on embankment, Rich Gulch, at 10 cts	8,400	
408,600	Cubic yards embankment, Butte Valley, at 40 cts	163,440	
190,700	Square feet paving on embankment, Butte Valley, at 10 cts.	19,070	
86,700	Cubic yards embankment, Livermore Pass, at 40 cts	34,680	
57,600	Square feet paving on embankment, Livermore Pass, at 10 cts.	5,760	
515	Acres, clearing and grubbing, at $30	15,450	
7	Waste weirs, at $750	5,250	
16	Miles four board fence around Reservoirs, at $600	9,600	
			$661,440

CANAL.

498,100	Cubic yards earth excavation, at 15 cts	$74,715	
2,554,000	Square feet paving, at 10 cts	255,400	
173,500	Cubic yards loose rock excavation, at 30 cts	52,050	
671,300	Cubic yards rock excavation, at 75 cts	503,475	
300	Acres, clearing and grubbing, at $30	9,000	
710	Tons wrought iron for 9,519 lineal feet syphons, at $120	85,200	
	Making and dipping syphons, 9,519 lineal feet, at $2.50	23,797	
	Trenching and backfilling for syphons, 9,519 lineal feet, at 40 cts	3,808	
98	Miles four-board fence, at $600	58,800	
			$1,066,245

TUNNELS.

5,075	Lineal feet tunneling, 9½ feet diameter, at $14	$71,050	
2,378,000	Bricks for lining tunnels, at $30 per M, laid	71,340	
			$142,390

CONDUIT.

78,153	Tons wrought iron for 330,748 lineal feet conduit, 60 inches diameter, from the end of canal to Livermore Pass reservoir, at $120	$9,378,360	
53,227	Tons wrought iron for 331,482 lineal feet conduit, 66 inches diameter, from Livermore Pass reservoir to Rock Creek reservoir, at $120	6,387,240	
	Making and dipping the conduit, 662,230 lineal feet, at $2.50	1,655,575	
	Trenching and backfilling for conduit, 662,230 lineal feet, at 40 cts	264,892	
1	Head gate at beginning of conduit	300	
26	Water gates, at $4,000	104,000	
			$17,790,367

SUBMERGED CONDUIT ACROSS SAN FRANCISCO BAY.

3	Pipes, each 6,433 feet long and 42 inches diameter, aggregate length, 19,299 feet, at $50, laid	964,950	
6	Water gates, 42 inches diameter, at $2,200	13,200	
			$978,150

DISTRIBUTION.

HIGH SERVICE DISTRIBUTING RESERVOIR.

1,498,000	Cubic yards embankment, Rock Creek reservoir, at 40 cts	$599,200	
285,500	Square feet paving on embankment, Rock Creek reservoir, at 10 cts	28,550	
	Waste pipe, Rock Creek reservoir	1,296	
10,500	Lineal feet picket fence, painted, at $1.00	10,500	
	30-inch wrought iron pipe for connecting conduit with low service reservoir, including valve	4,640	
	Effluent tunnel, including pipes and valves	62,798	
	City distribution, high service	747,558	
			$1,454,542

LOW SERVICE DISTRIBUTING RESERVOIR.

65,000	Cubic yards embankment, Islais Creek reservoir, at 40 cts.	$26,000	
33,800	Square feet paving on embankment, Islais Creek reservoir, at 10 cts	3,380	
	Waste pipe	696	
2,145	Lineal feet picket fence, painted, at $1.00	2,145	
	Effluent pipes and valves	9,138	
	City distribution, low service	1,121,338	
			$1,162,697
			$23,255,831
	Add 10 per cent. for engineering and contingencies		2,325,583
	Total cost Blue Lakes scheme		$25,581,414

CLEAR LAKE.

Clear Lake, drained by Cache Creek, is one of the sources examined to supply the city with water, and is situated in the central part of Lake County, California, at an elevation of 1,317 feet above the city base. The character of the adjacent country is mountainous and broken, exposing a surface generally timbered, with a lack of good soil. This locality is distinguished alike for minerals and excessive rainfall, and is the source of several large streams, some of which flow into the lake, and others into distant plains, and finally discharge into the Sacramento River. The catchment area, or water-shed, embraces some 400 square miles; the average rainfall, as taken from records of different measurements and observations, from 1867 to 1873, was found to be 34.4 inches per annum, fifty per cent. of which for utilization would amount to 119,565,000,000 gallons per annum, or 327,000,000 gallons daily.

The lake is of varied width, and 26 miles in length, comprising an area of 82 square miles; the depth in many places was found by sounding to be 50 feet, and the average depth is nearly 40 feet.

With regard to the quality of the water of Clear Lake, which has given rise to much comment, and various theories, the appended analysis will give its chemical character. The water has a peaty and rather unpleasant flavor, supposed by some to arise from several hundred acres of tules growing at the head and foot, and along the margin of the lake, and by others accounted for by the location of the lake in a mineral region abounding with sulphur and quicksilver deposits; and where borax and soda springs drain into and rise from the bottom of the lake. In this connection, Capt. Fraser, who is familiar with the lake and the surrounding country, and in whose steamer the exploration of the lake was made, politely furnished us with extracts from his carefully kept log book. He stated that the maximum rise and fall of the lake was about 8 feet; and this immense accumulation over 82 square miles of surface, which occurs even with the constant and great outflow through Cache Creek, amounts to 136,795,963.392 gallons, without the dam, which would be built under the contemplated plan of the works, to arrest and store the water, to draw from the above amount the 100,000,000 gallons required daily, would supply the city for 1,367 days. Capt. Fraser also stated that the water is most discolored, and has the strongest taste, when the sun is hottest, and the evaporation and fall of the lake greatest. This is during the months of June and July. That the observed daily fall of the lake, caused by the outflow and evaporation after the rainy season, was from ½ to 1½ inches per day, and that the lake has been known to fall 2 feet below the outlet, at which time Cache Creek, the natural channel of outflow, was for several miles from its source, entirely dry. But according to the testimony of old residents, this is a rare occurrence.

It appears from the experience had with the boiler of the steamer referred to, that after three months use no incrustation or deposit of a mineral or sedimentary nature was found, nor any injurious effects to the iron; which


CITY WATER SUPPLY
MAP
OF
CLEAR LAKE
From Surveys made under the direction of the
BOARD OF SUPERVISORS
OF THE
CITY AND COUNTY OF SAN FRANCISCO
by
T. R. SCOWDEN,
Chief Engineer of City Water Supply.
Scale 2000 Feet to the Inch
1875.
G. F. ALLARDT.
First Ass't Engineer.
Length of Aqueduct
Canal 22 40 Miles
Natural Channels 8 14
Flumes 0 65
Tunnels 8 04
Siphons 0 69
Conduit M 82
Submerged Pipe 5 32
From Clear Lake to San Francisco 127 24
C L E A R L A K E
Altitude 1317 feet above City Base
Area of Lake 82 84 miles
Cache Creek
Scotts Creek
Burns Lake
FOWLER MILL DAM
TUNNEL
Scotts Creek CANAL
Beginning of Canal
LOWER LAKE
LAKEPORT
UNCLE SAM
T.15N.R.9W.
T.15N.R.8W.
T.15N.R.10W.
T.14N.R.8W.
T.14N.R.7W.
T.14N.R.10W.
T.13N.R.8W.
T.13N.R.9W.
T.13N.R.7W.
Geo. H. Baker Engraver & Lithographer 108 Watts St. S. F.

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It appears from the experience had with the boiler of the steamer referred to, that after three months use no incrustation or deposit of a mineral or sedimentary nature was found, nor any injurious effects to the iron; which

has weight, and speaks well of the water for steaming purposes. Following the rains in the month of March, the water is clearest, but after that period the turbulence increases to that degree at times as to create a film over the lake's surface (probably from floating vegetation) so as to leave a plainly marked track after the steamer, and the water so affected is flocculent with matter in suspension to a great depth. Further, that after the rains, and during the highest stages of the lake, when the water is most palatable, and apparently purest, say from May to July inclusive, the fish are known to die in large numbers. Our party, in making the exploration in October last, observed that the condition of the water differed in the upper and lower portions of the lake; the former being, at particular places, highly discolored, while in the latter it was comparatively clear, but at all points it appeared charged, more or less, with matter in suspension. We also observed dead fish floating here and there, and a few apparently dying, especially about the middle and lower portions of the lake, and over the deepest places. We drank of the water near the spot, and in many places, but could perceive only a slight difference, if any, in the taste.

To speak of the character of the water in definite terms, and of the causes to which the phenomena described may be attributed, would be hypothetical, and would far exceed the limits of this report. It is the opinion of the chemist who analyzed the water, that though it is unpalatable, it is not unwholesome; furthermore, it has been suggested that the destruction to fish may be owing to the inhalation of gases, which escapes from the bottom of the lake, and which may be seen at adjacent places bubbling from springs. It is remarkable, however, that the crew of the steamer, and the residents along the border of the lake, drink the water with impunity; hence there is no evidence from the facts in the case that the water is unwholesome. Moreover, it is stated by unquestionable authority, that the water after flowing several miles from the outlet, becomes, by percipitation of the suspended matter and æration, clarified and palatable. It is soft water, and appears from all that is known chemically, to be well adapted to domestic and industrial purposes.

The water of Clear Lake will be raised 6 feet by building a dam 39 feet high across Cache Creek, 5 miles below the lake, where the stream turns abruptly into a deep mountain gorge, and passes on to the fertile valleys below. The construction of the proposed work for supplying the city with water, begins at this dam, where the water taken from the lake would be diverted into a canal (having a grade of 6.33 feet per mile), and flow 1,100 feet to a tunnel 2.9 miles in length, thence down the bed of a Soda Creek 1.15 miles to a point where it will be again diverted into a canal, extending 11.31 miles, to a point where its contents would be discharged into Coyote Valley reservoir. Within this distance are two syphons, 679 feet in length, and a tunnel 948 feet in length. The latter would pierce Eagle Eyrie, and connect with the canal resumed.

This reservoir is admirably located, as it commands an elevation of 1,015 feet above city base, with an approximate area of 10½ square

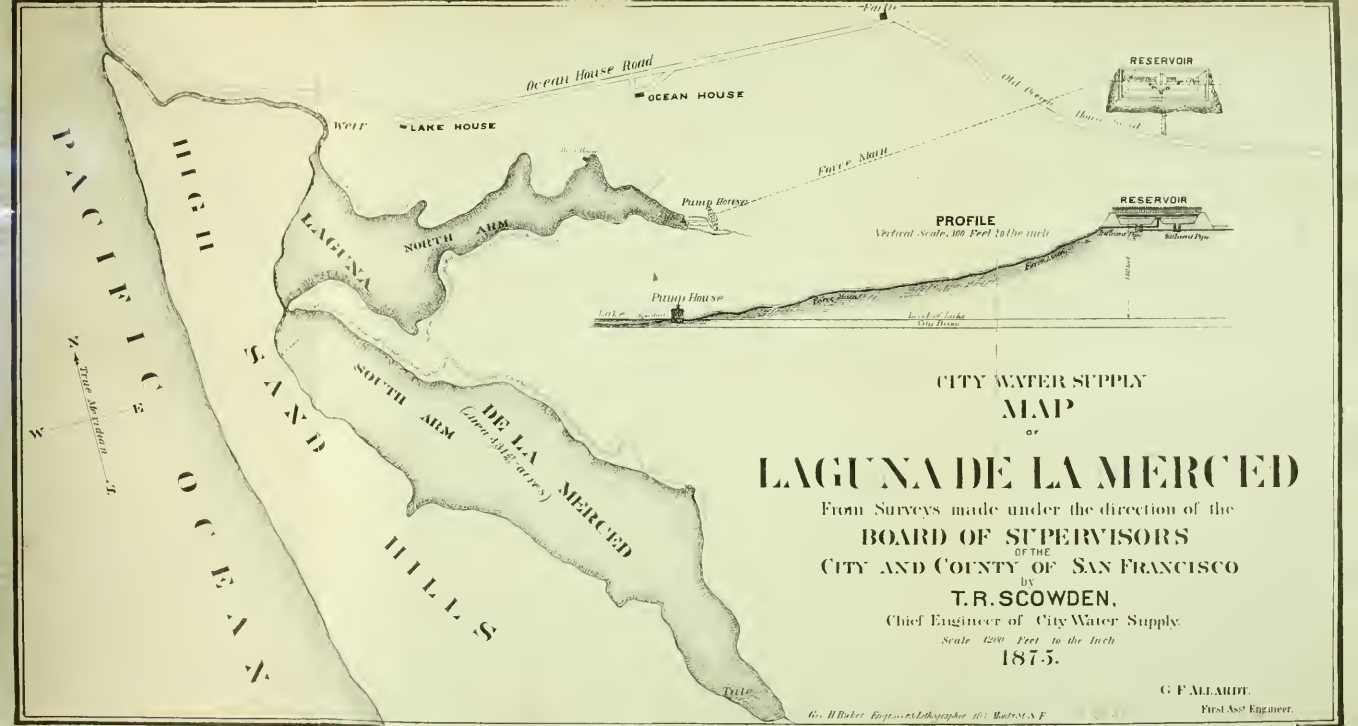
miles, and a storage capacity of 52,000,000,000,000 gallons; to this add the available supply of 102,584,000,000 gallons from Clear Lake to draw upon when necessary, and the quantity aggregates 154,584,000,000 gallons, which represents the annual quantity of water utilized and stored in these two immense reservoirs, less the evaporation and absorption—a quantity sufficient during a perfect drought, (considered as an extreme case) and without being replenished, to supply San Francisco with 100,000,000 gallons daily, during a period of some three years. It might be a longer or a shorter time, as the elements of absorption and evaporation, influenced by uninterrupted drought are involved, and in the absence of statistical data, render computation difficult. In California, however, partial, not complete, drought should be considered, and a plentiful supply for that contingency only provided for; in that respect it is safe to say, that these sources, even for a population of 1,000,000, would be practicably inexhaustible.

The Coyote reservoir would be formed by building two dams, one across Putas Creek Cañon, and one across Willow Slough 105 feet, and 84 feet high, respectively. This reservoir would derive its supply in part from Clear Lake and in part from its own water-shed, embracing St. Helena and Cobb mountains, and having an area of about 124 square miles, with an average annual rain-fall of 31.32 inches, constituting the prolific source of Putas Creek, a formidable mountain stream, from whence would be collected 67,380,000,000 gallons annually, 50 per cent. utilization of which represents 33,690,000,000 gallons, reservoir storage, for the supply of the city; the deficiency, if any in quantity, would be drawn from Clear Lake, a constantly replenishing source.

The chief object in mingling the water from these sources, in Coyote reservoir, would be to effect purification by the process of dilution and precipitation, and thereby remove the prejudice against Clear Lake alone as a source of supply. In this connection, the eradication of tule growth from the lake, by dredging, would also improve the quality and taste of the water.

The reservoir at its southerly extremity would be tapped by a tunnel 1.67 miles long, passing under Butte Pass, from whence the water would flow into a canal, extending along Butte Cañon 4.95 miles, to a divide between that cañon and Pope Valley.

Intermediate on this line, a syphon 1,232 feet in length would convey the water across the north fork of Butte Creek, and another syphon, 1,774 feet in length, would further conduct the water across the main Butte Creek. Continuing the supply line, the above mentioned divide would be pierced by a tunnel, 2,794 feet in length, conveying the water into the canal resumed in Pope Valley; thence along the northerly slope of the valley the canal would terminate and discharge its contents into head works, connected with the pipe line or conduit, 64 inches in diameter, and extending 87.36 miles to the city. From the initial point of the conduit, at an elevation of 896 feet above city base, the same would extend to Chiles' Valley and cañon, 6.5 miles, to a divide, through which it would pass in a tunnel, 3.1 miles in length; thence to Yountville; thence along the Napa Valley Railroad to North Vallejo; thence



CITY WATER SUPPLY

MAP

OF

LAGUNA DE LA MERCED

From Surveys made under the direction of the

BOARD OF SUPERVISORS

OF THE

CITY AND COUNTY OF SAN FRANCISCO

BY

T. R. SCOWDEN,

Chief Engineer of City Water Supply.

Scale 1200 Feet to the Inch

1875.

G. F. ALLARDT.

First Asst Engineer.

to Dillon's Point, a distance of 42.06 miles. From the last named place the conduit would pass under Carquinez Straits, following the curvature of the bottom, 2,800 feet to the opposite shore; thence along and over the adjacent heights 2.1 miles, to Carquinez reservoir, where it would deliver, for the present, 50,000,000 gallons of water daily. Provision would be made for attaching another conduit when the wants of a greater population would demand it. The Carquinez reservoir would be formed by building a dam 194 feet high across the valley of one of the tributaries of Rodeo Creek, with an elevation of 629 feet above city base, and a capacity of 504,555,000 gallons; thence the conduit would extend along the southerly foothills and valleys to the San Pablo Road; thence to Peralta street in the City of Oakland; thence to Railroad avenue; thence to Oakland Point; thence passing under the Bay of San Francisco for 26,328 feet, would emerge from the water and enter the city at the intersection of South and Water Front streets, in Mission Bay; thence along South street to Center street; thence along Center street to Market street, and along Market to Seventeenth street; and thence to Rock Creek reservoir, the terminus of this and the Blue Lakes conduit, distant 32.22 miles from Carquinez reservoir, and 87.36 miles from the initial point of the conduit, making the total line of works from Clear Lake to San Francisco 127.23 miles in length.

RECAPITULATION.

Aggregate length of canal and conduit	127.23 miles
Comprising canal	22.40 miles
" natural channels	8.14 miles
" 18 flumes of wood, 3,431 feet, or	.65 miles
" 6 tunnels	8.01 miles
" 4 syphons, 3,685 feet, or	.69 miles
" conduit	87.34 miles
	127.23 miles

Of the conduit, 26,328 feet would be submerged under the Bay of San Francisco, and 2,800 feet under the Straits of Carquinez, both subject to the action of salt water.

ROUTE OF THE ORIGINAL SURVEY.

Commencing at terminus of canal, 896 feet above base, the initial point of conduit above described, the original survey was continued along the northerly slopes of Pope Valley, a distance of 8.99 miles, to the terminus of the canal by this route, near the mouth of Pope's Creek. Here the conduit, at its initial point would connect with the canal, at an elevation of 836 feet above base, and extend along the slope of the hill to the mouth of Pope's Creek; thence, entering Beryessa Valley, would extend along the valley to and through Putas Cañon; thence through Seaman's Valley; thence through Pleasant Valley; thence through Vaca Valley; thence through Suisun Valley; thence across the mouth of Green Valley; thence along the foot-hills skirt-

ing the tule swamps, passing to the north and west of Bridgeport and Benicia to Dillon's Point; thence across the Straits of Carquinez to the opposite shore; thence along ascending ground to the Carquinez reservoir, a distance of 59.15 miles from the initial point of conduit. From Carquinez reservoir to Rock Creek reservoir in the city, the water would be conducted by conduit along the same route, and in the same manner, as that described for the other conduit.

CLEAR LAKE—ESTIMATE OF COST.

RESERVOIRS.

18,100	Cubic yards embankment, Cache Creek, at 40 cts.....	$7,240	
13,300	Square feet paving embankment, Cache Creek, at 10 cts..	1,330	
367,600	Cubic yards embankment, Putas Creek, at 40 cts.....	147,040	
102,400	Square feet paving embankment, Putas Creek, at 10 cts..	10,240	
290,000	Cubic yards embankment, Crabtrees, at 40 cts	116,000	
118,700	Square feet paving embankment, Crabtrees, at 10 cts.....	11,870	
1,437,500	Cubic yards embankment, Carquinez, at 40 cts.....	575,000	
301,800	Square feet paving embankment, Carquinez, at 10 cts....	30,180	
4	Waste weirs.....	3,000	
24	Miles four-board fence around reservoirs, at $600.....	14,400	
			$916,300

CANALS.

206,300	Cubic yards earth exeavation, at 15 cts.....	$30,945 00	
315,000	Cubic yards loose rock excavation, at 30 cts.....	94,500 00	
61,800	Cubic yards rock exeavation, at 75c.....	46,350 00	
41	Aeres clearing and grubbing, at $30.....	1,230 00	
4,625	Tons wrought iron for 3,685 lineal feet of syphon, at $120	55,500 00	
	Making and dipping 3,685 lineal feet of syphon, at $2.50..	9.212 50	
	Trenching and back-filling for syphon 3,685 feet, at 40 cts	1.474 00	
3,431	Lineal feet of fluming, at $3.....	10,293 00	
			$249,504 50

TUNNELS AND APPROACHES.

24,388	Lineal feet of tunneling, 7½ feet diameter, at $9.20.....	$224,369 60	
19,512	Lineal feet of tunneling, 9½ feet diameter, at $14.....	273,168 00	
38,918	Cubic yards earth exeavation for tunnel approaehes, at 20c	7,783 60	
38,918	Cubic yards roek exeavation for tunnel approaehes, at 75e	29,188 50	
18,227,000	Brick for lining tunnels at $30 per M, laid.	546,810 00	
			$1,081,319 70

CONDUIT.

54,639	Tons wrought iron for 288,884 lineal feet of conduit 64 inches diameter, from end of canal to Carquinez reservoir, at $120 per ton.....	$6,556,680 00	
23,594	Tons wrought iron for 146,046 lineal feet of conduit 62¾ inches diameter, from Carquinez reservoir to Rock Creek reservoir, at $120 per ton.....	2,831,280 00	
	Making and dipping the conduit 434,930 lineal feet, at $2.50.....	1,087,325 00	
	Trenching and back-filling for conduit 434,930 lineal feet, at 40 cts.....	173,972 00	
	Head-gate at beginning of conduit.....	300 00	
18	Water gates, at $4,000.....	72,000 00	
			$10,721,557 00

SUBMERGED CONDUIT.

	Across the straits of Carquinez: 3 pipes 42 inches diameter, 2,800 feet long (aggregate length, 8,400 feet), at $50, laid	$420,000 00	
	Across the Bay of San Francisco: 3 pipes 42 inches diameter, 26,328 feet long (aggregate length, 78,984 feet), at $50, laid	3,949,200 00	
12	Water gates at ends of submerged conduit, at $2,200	26,400 00	
			$4,395,600 00

DISTRIBUTION—HIGH SERVICE.

1,498,000	Cubic yards embankment, Rock Creek reservoir, at 40 cts.	$599,200 00	
285,500	Square feet paving on embankment, at 10 cts	28,550 00	
1	Waste pipe	1,296 00	
10,500	Feet picket-fence, painted, at $1	10,500 00	
	Wrought iron pipe, 30 inches diameter, 9,500 feet long, for connecting conduit with low-service reservoir, including valve	36,430 00	
	Effluent tunnel, including pipes and valves	62,798 00	
	City distribution—high service	747,558 00	
			$1,486,332 00

LOW SERVICE.

65,000	Cubic yards embankment, Islais Creek reservoir, at 40 cts.	$26,000 00	
33,800	Square feet paving on embankment, at 10 cts	3,380 00	
1	Waste pipe	696 00	
2,145	Feet of picket-fence, painted, at $1	2,145 00	
	Effluent pipes and valves	9,138 00	
	City distribution—low service	1,121,338 00	
			1,162,697 00
			$20,013,310 20
	Add 10 per cent. for engineering and contingencies		2,001,331 02
	Total cost of Clear Lake scheme		$22,014,641 22

LAGUNA DE LA MERCED.

Laguna de la Merced is situated on the peninsula, about six miles in a southwesterly direction from the new City Hall of San Francisco, and nearly a quarter of a mile from the Pacific coast. It comprises two bodies of water, connected by a narrow neck or channel, through which the more southerly and larger body is continually flowing into the smaller one, with a moderate current. This body has a general northwesterly direction, and at its southern extremity crosses the southern boundary of the city and county of San Francisco.

The smaller lake, from whose northerly extremity the common effluence

for the two lakes occurs, which is the only outlet, has a general easterly direction. On the banks of this body of water, and on that arm of the lake nearest to the city, it is proposed to erect the necessary pump-house and works, thus securing the shortest pipe-line for conveying the water to the reservoir.

The banks of both divisions of Laguna Merced are generally abrupt and high, though the westerly shore of the larger division descends in an easy slope from the coast-range of hills, which shut the lake in from the sea, and forms a barrier to any ingress of salt water.

The subsoil cropping out around the lakes, where the bluff banks occur, is of an indurated, sandy character, suitable for the pump-house foundations, without the usual cost of piling and other artificial means for securing solidity and permanence.

The water-shed, or that area of the adjacent country, the slopes of which convey the rain-fall, either by surface drainage or absorption, and subsequent percolation, to the lakes, is nearly seven and a half square miles, as taken from the U, S. Coast Survey.

The source from which the lake receives its supply is, as in other cases, accounted to the rain-fall on the water-shed, which from the very porous nature of the soil at once finds its way to the water-bearing stratum, and thence by a constant and slow process filters through to the lake, and may, in part, be seen at all times oozing out from the banks at and above the edge of the water at many places around the shores ; though the water suspension throughout districts of this nature, even at great levels above the common reservoir of drainage (which would indicate an entire saturation of the whole body of land included within the water-shed, and may be attributed to capillary attraction), must offer a constant resistance to the process of percolation ; and this saturation may be observed at slight distances below the surface after a long-continued drought.

The supply of water to the lakes, which under the varying influence of the seasons, obtains a sensible, though small change, bears a certain ratio to the entire rain-fall. To determine the amount of rain-fall by the common means of gauge is easy. The effective supply was obtained by accurate weir measurements of the outflow, which, while the water level in the lake remains unchanged, expresses both the daily influence and effluence of water. The difference between the rain-fall and the outflow fixes the loss the rain-fall suffers in reaching the lake, and the ratio of the discharge to the rain-fall establishes the co-efficient of utilization during the period of weir observations.

The actual mean rain-fall on this water-shed of seven and a half square miles, taking the average of twenty-five years' observations at San Francisco, 23.9 inches (*vide* Tennent's Nautical Almanac), to be true for the Laguna Merced district, was found equal to 3,115,140,000 gallons per annum, or 8,534,630 gallons per day.

The weir measurements for obtaining the minimum flow from Laguna Merced, conducted under the past investigation, were begun early in September of 1874, and continued through a short period, under very annoying disturb-

ances. The minimum, mean, and maximum of these observations were observed. The maximum, which corresponds closely with the daily storage, as deduced from the mean annual rain-fall of 23.9 inches, noted above, should be accepted as approximating the mean daily flow throughout the year, and equals 5,680,434 gallons per day. The utilization of the rain-fall equals the ratio of the observed outflow to the mean daily rain-fall, $\frac{5,680,434}{8,534,630}$, or 66 per cent.; but since the maximum measurement for the rainy season could not be obtained, owing to the disturbances spoken of, and the final malicious destruction of the weir, the true daily mean would doubtless approximate very closely to the maximum of these observations, so as to safely make the utilization 66 per cent. of the rain-fall, furnishing a mean supply of 5,632,856 gallons per day; this excess of utilization evidently being due to the cause of a surrounding indurated water-bearing basin, which renders its whole percolation of the rain-fall to the lake, excepting that portion lost by evaporation; making this an exceptional case, as the loss by absorption in others is here obviated by the character of the sub-conformation.

The true mean supply could only be ascertained by continued observations, running through a series of years. Still, for the purposes of comparison, the 50 per cent. utilization, as in other cases, is adhered to, which would give an available supply of 4,267,315 gallons per day. The question of evaporation, in this case, it is unnecessary to discuss, as the utilization for minimum supply to the city was measured by the weir.

It is said that by lowering the level of water in the lakes, and so diminishing the column of water opposed to the channels of percolation, the supply may be increased, but would this not be temporary merely? Would this reduce the causes of loss, such as evaporation and absorption? Would not the remarkable uniformity of flow now observed throughout the year, though the influence of seasons varies considerably, be disturbed only by this change in the relations of the column of water? Would not the present relation of the saturation of the water-shed and the water level in the lake after a temporary increase of drainage, again obtain after the relief to the column of water suspended in the hills had been exhausted? It is believed that it would be.

The storage capacity of the lake may be increased by dredging out the ravines which have evidently been filled by the wash of soil from the hills, and the decomposition of weeds and other vegetable matter. To remove this and the tules with which the lake abounds, would clarify and improve the water, though the quality is good (see analysis). This work would add an element of cost not estimated.

The pump house to be located as mentioned, on one of the arms of the smaller lake.

The foundations for pump house and engine to be built of substantial stone masonry, laid in hydraulic cement. The pump well to be provided with a water-gate for letting on and shutting off the water that it may be emptied as occasion requires. The excavation for the foundations to be carried down to a point at least five feet below low water mark. The walls to be generally

rubble and the exposed front to be rock-faced masonry, and capped with a hammer dressed water table, the whole to be designed with a view to permanence and solidity.

An aqueduct or canal built of brick masonry laid in hydraulic cement to be connected with the foundations, for conducting the water from the lake to the pump well, to be provided with a strainer for preventing any accumulation of weeds in the pump well.

The superstructure or engine house to be built of brick masonry, consisting of a main building for the engines, and two wings for the boilers and furnaces, also two brick smoke-stacks. The door and window sills and cap to be of iron. The whole to be covered with an iron truss roof, slated, to render the building as fire-proof as practicable. To be two tenement houses, one for the engineer, the other for the fireman and watchman. The grounds to be improved in the way of fencing, walks, etc., at a moderate cost.

The engines, of which there will be two, to be of the Worthington duplex pattern, these works might be started with one engine, but I would not recommend the measure, as past experience has proved the policy and economy to be bad. The money expended in two engines instead of one, is the best investment in the construction of the works, as in the event of accident to one engine there would be a duplicate to continue and keep up uninterrupted supply of water which would otherwise be for a long time suspended while making repairs. Water works should be of such character and capacity as to maintain an uninterrupted supply of water, by placing them as nearly as possible beyond the contingency of accident. Each of these engines to have a capacity of 5,000,000 gallons per twenty-four hours.

The growing preference for these engines for water works purposes, and their continued favorable comparison with the best pumping machinery in use strongly recommends their adoption; many of them are in practical operation and have been thoroughly tested for the past sixteen years. It is conceded by competent and impartial judges of the performance and merits of machinery, that the duplex engine, for their efficiency, economy of working and required attendance is unsurpassed. As an example of their performance, the following is an extract from a "Report of Experts and Engineers appointed to test the duty and capacity of the Worthington pumping engine at Belmont." The tests were of two kinds. First.—The duty test, by which is meant the ability of the engine to perform a given amount of work, and is expressed in the usual way, of pounds raised one foot high, with one hundred pounds of coal. Second.—The capacity test, or actual discharge at the reservoir; this is expressed in cubic feet or gallons, and the amount by which this falls short of the theoretic of calculated capacity of the pumps, represents the amount lost by leakage through the pump valves, plunger, etc. Duty calculated from actual evaporation.

(Displacement of plunger in lbs. per stroke,	(Stroke of engine in 40 hours and 20 mins,	(Height of delivery in feet,
696.2	139,604	217.74

38,890 lbs. of Coal.

54,416,694 pounds raised one foot high, with one hundred pounds of coal.

being in excess of the guaranteed duty 8 $\frac{83}{100}$ per cent. On the basis of an evaporation of 9½ pounds of water with one pound of coal, which the contract with Mr. Worthington allows, the duty would be 63,120,707 pounds, or an excess of 26 $\frac{24}{100}$ per cent. over the contract requirement.

The quantity of water discharged at the reservoir was measured over a weir, carefully constructed under the direction of Mr. T. Risdon, a gentleman practically acquainted with the mode of measuring water. Under his directions, also, the observations and calculations were made. From these it appears that the pumps delivered into the reservoir in 48 hours and 20 minutes 1,500,584.52 cubic feet of water, equal to 11,225,122 gallons, or at the rate of 5,513,853 gallons in twenty-four hours, being $11\frac{47}{100}$ per cent. in excess of 5,000,000 gallons guaranteed by the contract.

The discharge of the pumps calculated from the displacement of the plunger was 5,795,200 gallons in twenty-four hours, being more than that determined by weir measurements of 3 $\frac{8}{10}$ per cent. It will not be correct to assume that the whole of this difference is due to leakage by and through the pump, and in order to ascertain as nearly as possible the amount due to that cause it may be observed that during the whole test some portion of the injection water for the condenser was taken from the pump main; the suction injection at the high temperature of the river not furnishing sufficient. This quantity was not less than 100 gallons per minute, which would make the loss by leakage through the pump not exceeding ½ per cent.

Cost of pumping five million gallons per diem from Laguna Merced to the distributing reservoir.—At the Belmont works in Philadelphia the cost of raising one million gallons one foot high by the Worthington duplex pumps, was found, in 1871, to be eight and one-half cents. The coal used was the best quality of anthracite—average cost six dollars per ton. At San Francisco, the same coal would cost at least fifteen dollars per ton, and assuming all other expenses, such as labor, repairs, etc., to be the same as at Philadelphia, then the cost of raising one million gallons one foot high would not be less than seventeen cents. The cost of raising five million gallons 340 feet high would therefore be: $5 \times 17 \times 340 = \$289$ per day, or $105,485 per annum.

The Forcing Main to be circular, of wrought plate iron, twenty-four inches diameter, connected with the pumps and extending to the reservoir 5,865 feet long, of sufficient strength and capacity to convey the water under a pressure of 340 feet head.

The Reservoir to be located near the old Ocean House road, about half a mile westerly from the Industrial School, its elevation to be 340 feet above city base, and its capacity 100,000,000 gallons. The construction of the reservoir will consist of throwing up embankments, and such division embankments as may be determined upon, suitable influent and effluent chambers to be provided, also means for draining and cleaning. The tops of the embankments to be laid out in walks, protected by appropriate fencing. The outside slopes to be sown in grass, and the inside slopes to be well paved or shingled. The slopes to be three horizontal to one vertical. The whole to be so arranged with pipes as to facilitate the storage and distribution of water.

The Supply Main to be 24,500 feet long, and 30 inches diameter, extending from the reservoir to connect with the pipes laid for distribution in the city.

ESTIMATES OF COST.

AQUEDUCT.

198 Cubic yards of masonry, laid in cement, at $13	$2,574 00	
198 Superficial yards pavement, at 50 cts	99 00	
Wood covering for same	32 00	
		$2,705 00

ENGINE HOUSE FOUNDATIONS.

Foundation laid in cement, 691.84 cubic yards, at $13.50	$9,339 84	
Brick superstructure, 2 steam furnaces and chimney stacks	32,000 00	
Indurated sand excavation, 4,039.26 cubic yards, at 25 cts	1,009 82	
Tenement for Engineer	3,000 00	
Tenement for Fireman	2,500 00	
Two coal houses	2,000 00	
Wood picket-fence, 710 feet lineal, at $2	1,420 00	
Macadam walks, 200 cubic yards laid, at $5	1,000 00	
Roadways, grading and improving grounds	6,500 00	
Extra labor, lumber and hauling	2,500 00	
		861,269 66

PUMPING ENGINES AND FORCE MAIN.

Two pumping engines, Worthington duplex, at $45,000	$90,000 00	
One wrought plate force main, 24 inches diameter, 5,865 feet long, full ¼-inch thick, 310.92 tons, at $180	55,965 60	
Excavation and back-filling pipe trench, 2,869.44 cubic yards, at 25c	717 36	
Two 24-inch water gates, at $330	660 00	
		$147,342 96

RESERVOIR AND APPURTENANCES.

Real estate, 45.91 acres, at $2,000	$91,820 00	
Reservoir embankment, 600,000 cubic yards, at 40 cts	240,000 00	
Rock excavation, 162,000 cubic yards, at $2	324,000 00	
Wood picket-fencing, 2,564 feet lineal, at $2	5,128 00	
Masonry in cement, 300 cubic yards, at $13.50	4,050 00	
Loose stone lining for inner slopes of embankment, 2,500 cubic yards, at $2	5,000 00	
Roadway, macadam, etc., 956.30 cubic yards, at $1	956 30	
Influent pipe, 780 feet long, 24 inches diameter, 30.62 tons, at $180	5,511 60	
Effluent pipe, 750 feet long, 24 inches diameter, 29.45 tons, at $180	5,301 00	
Drain pipe, 610 feet long, 24 inches diameter, 23.95 tons, at $180	4,311 00	
Trenching and back-filling 1,426.66 cubic yards, at 25 cts	356 66	
Six 24-inch water gates, at $330	1,980 00	
		$688,414 56
		$899,732 18
City distribution—low service		1,121,338 00
		2,021,070 18
Add 10 per cent. for engineering and contingencies		202,107 02
Total cost of Laguna Merced scheme		$2,223,177 20

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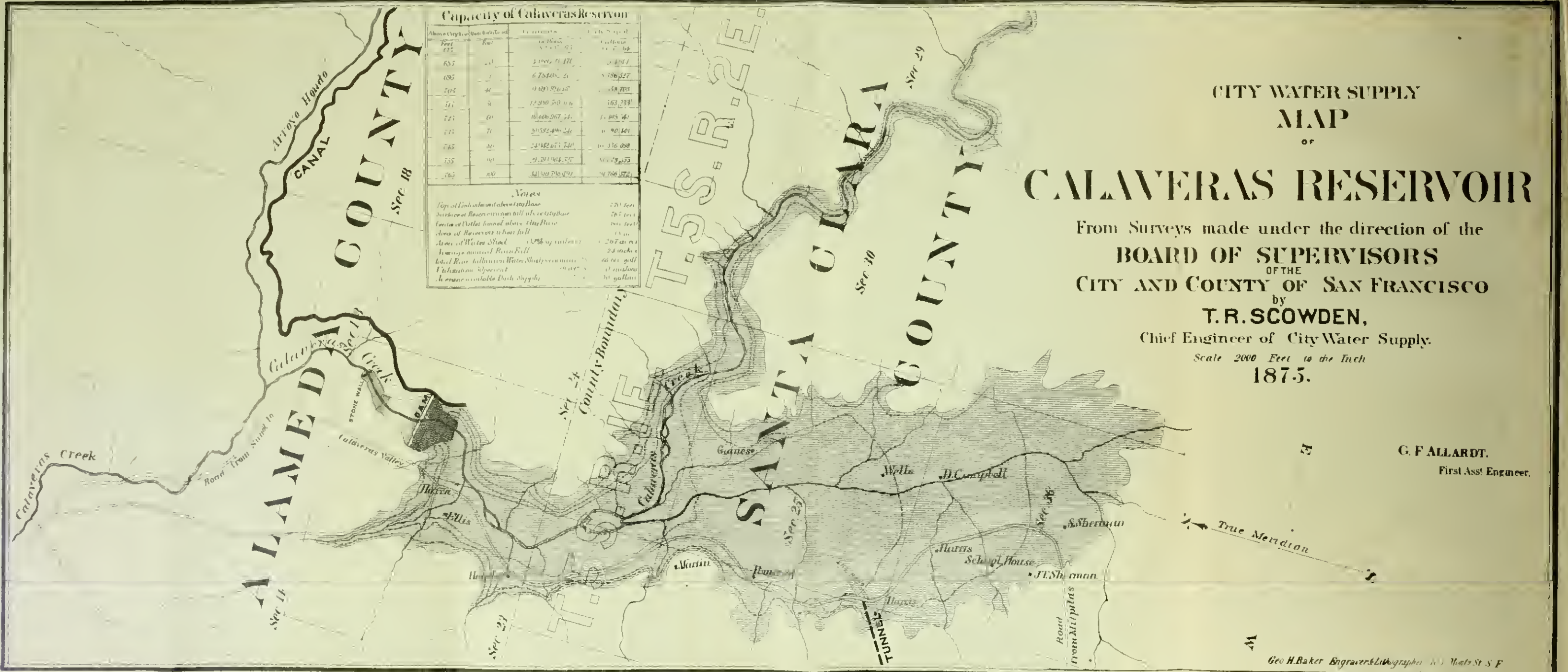
CITY WATER SUPPLY
MAP
OF
CALAVERAS RESERVOIR
From Surveys made under the direction of the
BOARD OF SUPERVISORS
OF THE
CITY AND COUNTY OF SAN FRANCISCO
by
T.R.SCOWDEN,
Chief Engineer of City Water Supply.
Scale 2000 Feet to the Inch
1875.
G. F ALLARDT.
First Asst Engineer.
Capacity of Calaveras Reservoir
Notes
ALAMEDA COUNTY
SANTA CLARA COUNTY
T.5.S.R.2.E.
T.5.S.R.1.E.
County Boundary
Calaveras Creek
Arroyo Hondo
CANAL
DAM
STONE WALL
Calaveras Valley
Road from Sunol to
Sec 18
Sec 24
Sec 23
Sec 25
Sec 30
Sec 29
Sec 36
Wells
D. Campbell
Ellis
Martin
Harris
School House
J.T.Sherman
S.Sherman
TUNNEL
Road from Milpitas
True Meridian
Geo H.Baker Engraver & Lithographer

CALAVERAS VALLEY.

Calaveras Creek is the principal south fork of Alameda Creek, and takes its rise in the most elevated regions of the Mount Diablo range. Its general course is northwesterly, and its length is about 38 miles. It is proposed to collect and store the waters of the Calaveras Creek, together with the waters of its largest tributary, the Arroyo Honda, in an immense reservoir, covering the entire Calaveras Valley, by means of a dam or embankment thrown across the narrow cañon at the outlet of the valley, and thus form a reservoir in which would be water stored with head and force sufficient to flow by gravitation to the distributing reservoir in the City of San Francisco.

The Calaveras reservoir would be tapped at its westerly side by means of an outlet tunnel, perforating the hills lying between the Calaveras Valley and San Jose Valley; the water drawn thence would flow in a wrought-iron conduit 60 inches diameter, and 45.58 miles in length to the Rock Creek or main distributing reservoir in San Francisco.

The area of the watershed of Calaveras Creek above the point selected for the embankment, is 101.28 square miles; of the Arroyo Honda, 38.20 square miles; total watershed, 139.48 square miles, of which 16.79 square miles are situated in Alameda county, and 122.69 square miles in Santa Clara county. With the exception of Calaveras Valley the country is extremely precipitous, unfit for cultivation, and covered for the greater part with dense masses of chemisal, interspersed with forests of pine and oak. The hills bordering the San Jose Valley directly east, consist of sandstone only slightly metamorphic and contain numerous fossils, mostly in a bad state of preservation, sufficient, however, to fix the age as tertiary. Passing easterly after crossing the valley at its easterly base, there is a region of highly metamorphic rock, which in places might be termed slate. On the easterly side of this is a deep valley (the site for reservoir), and crossing this strikes Calaveras Creek and ridge, which leads to the summit of Mt. Hamilton,* located centrally within the Calaveras watershed, in a direction nearly transverse to the main chain, or northeast and southwest. This ridge is of metamorphic sandstone, although not so highly altered as are portions of the great mountain mass to the east, and the strata are much broken and often standing nearly vertical.

Mount Hamilton, the highest point of the group, and the highest peak north of San Carlos extending as far as Clear Lake, is 4,448 feet above the level of the sea. From its summit, which is of easy access, there is a fine view, not only of the beautiful and fertile valley of San Jose, but of the wild, and entirely uninhabited and unknown region to the east, northeast, and southeast of the Calaveras and Arroyo Honda.

With regard to reservoir sites within the boundaries of the Calaveras watershed, there are three besides the main storage reservoir in the valley; one site on the Arroyo Honda for a reservoir at an elevation of 800 feet above base, of 404,000,000 gallons capacity; another site still higher, the elevation of which was not exactly determined, is near the mouth of Smith's Creek, a tributary

* This mountain has been selected for the site of the Lick Observatory.

of the Calaveras, of 1,500,000,000 gallons capacity; another near the base of Mount Hamilton of 800,000,000 gallons capacity, higher than the former; lastly, in Santa Isabel Valley, near the head-waters of the Calaveras, at an elevation of over 2,500 feet, there is a fine site for a reservoir of 9,000,000,000 gallons capacity. This watershed, comprising nearly 140 square miles, is for adaptability, freedom from contamination, and for excellence of water, one of the best that can be found in the country.

From observations made in Calaveras Valley, we find that the rainfall is substantially the same as at San Francisco, where the annual average is 23.9 inches. In the more elevated regions the rainfall is undoubtedly much greater. At Colfax, for instance, on the Central Pacific Railroad, the altitude of which is 2,422 feet, or about the average altitude of the Calaveras watershed, the mean rainfall exceeds 50 inches, or more than double that of San Francisco; yet, to be within absolutely safe limits, 24 inches has been adopted as the average annual rainfall. Then the total annual amount of water falling on the watershed above described, namely on an area of 139 48 square miles, equals 58,175,666,600 gallons. As in other cases, take one-half as the percentage of utilization, that is, 29,087,833,300 gallons, which gives an available daily supply of 79,692,690 gallons, leaving a surplus of nearly 30,000,000 gallons per day more than sufficient to supply 100 gallons to each inhabitant for a population of 500,000, which surplus may be used to supply San Jose, Milpitas, and all the towns along the line of the conduit from Calaveras Valley to the city of San Francisco.

The Reservoir.—To provide for unusually wet seasons, the capacity of the reservoir is made to exceed somewhat the required average storage, above deduced, by an increased depth of 10 feet. Its surface, when full, will then be 100 feet above the center line of the outlet tunnel, and 765 feet above the city base of levels.

Top of embankment above city base	770 feet.
Surface of reservoir above city base	765 feet.
Center of outlet tunnel above city base	665 feet.
Area of reservoir, when full	1,568 acres.
Depth of water prism to draw from	100 feet.
Total amount of water stored when the reservoir is full,	34,589,800,000 galls.
Daily supply for 365 days without replenishing	94,766,575 galls.

(See tables of rainfall, discharge, &c., in Supplemental Reports.)

To convey the water of the Arroyo Honda to the reservoir, will require a canal 18,000 feet, or 3.41 miles in length, which will enter the reservoir from its eastern slope.

The site or basin referred to has a well defined and prominent rim, standing at points from 300 to 1,000 feet above the capacious basin or valley. Evidently the basin was once a lake, through the side of which the abrasion of water and sediment flowing over it from the creek for an indefinite period, has cut a narrow gap from the top to the bottom of the basin at its present outlet. It is proposed to restore this basin to its ancient or original form by

stopping up the gap, or cañon, by means well known to practical and experienced engineers.

The site selected for the embankment is extremely favorable, being located in Alameda county, near the lower end of Calaveras Valley, where it becomes a steep and narrow cañon. The length of the embankment would be 1,080 feet ; width on top, 50 feet ; slopes, 1 vertical to 4 horizontal. Suitable material for making the embankment is found in great abundance, and within easy hauling distance.

The Conduit.—The route of the conduit is as follows: beginning at the westerly end of the outlet tunnel, thence southwesterly descending into the San Jose Valley, passing through the town of Milpitas, and extending around the Bay of San Francisco, near Alviso; thence northwesterly over level ground, and nearly in a straight line, to the county road at Menlo Park ; thence northerly along and in the county road to the Twelve-mile Farm, or Baden Station, on the Southern Pacific Railroad ; thence in a straight line to Abbey Summit in the city; thence to a point near San Miguel Station; thence in a straight line, passing between the Industrial School and the Railroad, to its terminus in Rock Creek Reservoir, which it enters at its southern end, at an elevation of 450 feet above city base. Length of conduit, 45.58 miles.

ESTIMATE OF COST.

CALAVERAS RESERVOIR.

3,213,000	Cubic yards embankment, at 40 cts	$1,285,200	
598,200	Square feet paving on embankment, at 10 cts	59,820	
1,260	Cubic yards dry wall at foot of embankment, at $4	5,040	
	Waste weir	750	
12¾	Miles of four-board fence to enclose reservoir, at $600	7,650	
250	Acres grubbing and clearing, at $30	7,500	
			$1,365,960

CANAL FROM ARROYO HONDA.

50,000	Cubic yards earth excavation, at 15 cts	$7,500	
58,000	Cubic yards rock excavation, at 75 cts	43,500	
1	Timber dam	1,750	
			52,750

TUNNEL.

7,950	Lineal feet of tunnel from reservoir to beginning of conduit, 7½ feet diameter, at $9.20	$73,140	
2,993,000	Brick for lining tunnel, at $30 per M, laid	89,790	
			162,930

CONDUIT.

39,508	Tons wrought iron for 240,680 lineal feet of conduit, 60 inches diameter, at $120	$4,740,960	
	Making and dipping the conduit, 240,680 feet, at $2.50	601,700	
	Trenching and back-filling for conduit, 240,680 ft., at 40 cts.	96,272	
	Head gates at beginning of conduit	8,000	
	Extra attachments at beginning of conduit	600	
10	water gates, at $4,000	40,000	
			5,487,532

DISTRIBUTION.

HIGH SERVICE.

1,498,000	Cubic yards embankment, Rock Creek reservoir, at 40 cts.	$599,200	
285,500	Square feet paving on embankment, at 10 cts	28,550	
1	Waste pipe	1,296	
10,500	Feet picket fence, painted, at $1	10,500	
	Wrought iron pipe, 30 inches diameter, 1,000 feet long, for connecting conduit with low service reservoir, including valve	4,640	
	Effluent tunnel, including pipes and valves	62,798	
	City distribution, high service	747,558	
			1,454,542

LOW SERVICE.

65,000	Cubic yards embankment, Islais Creek reservoir, at 40 cts.	$26,000	
33,800	Square feet paving on embankment, at 10 cts	3,380	
1	Waste pipe	696	
2,145	Lineal feet picket fence, painted, at $1	2,145	
	Effluent pipes and valves	9,138	
	City distribution, low service	1,121,338	
			1,162,697
			$9,686,411
	Add 10 per cent. for engineering and contingencies		968,641
	Total cost of Calaveras scheme		$10,655,052

SPRING VALLEY WATER WORKS.

In due course the sources, watersheds, and streams of the Spring Valley Water Works were reached, and made the subject of inquiry. These works are in operation and supply the city with water. They combine gravitation works with pumping service; the latter, however, only to a limited extent, for supplying the upper portion of the city, where water from the sources can not flow by gravitation.

The Pilarcitos reservoir, or Lake Pilarcitos, has an elevation of 696 feet above base, and a storage capacity of 1,180,000,000 gallons, which is supplied from a watershed of 3.75 square miles, and an average annual rainfall of 58 inches, yielding 3,770,000,000 gallons, 50 per cent. of which is 1,885,000,000 gallons, and a daily average supply of 5,160,000 gallons.

The San Andres reservoir, or Lake San Andres, has an elevation of 438 feet above base, and a storage capacity of 4,530,000,000 gallons; by increasing the height of the dam 16 feet, a work now in progress, and which will be finished during the coming season, the storage capacity will be increased to 6,500,000,000 gallons. The watershed, including Lock's Creek, San Mateo, and lower Pilarcitos, and the waste water of the upper Pilarcitos, supplying the San Andres reservoir, has an area of 10.81 square miles, as now used, and an

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CITY WATER SUPPLY
MAP
OF
SPRING VALLEY RESERVOIRS
From Surveys made under the direction of the
BOARD OF SUPERVISORS
OF THE
CITY AND COUNTY OF SAN FRANCISCO
BY
T. R. SCOWDEN.
Chief Engineer of City Water Supply.
Scale 2000 Feet to the Inch
1875.
C. F. ALLARDT.
First Asst Engineer.
SAN ANDRES RESERVOIR
DAM
PROPOSED
CRYSTAL SPRINGS
DAM under Construction
LAGUNA GRANDE
RESERVOIR
Proposed Dam
Flume From Lake's Creek
San Andres Creek
Tunnel
San Mateo Creek
Flume
Lower Plantas Reservoir
Plantas Reservoir
Flume
Flume
Pilarcitos Creek
PILARCITOS RESERVOIR
DAM
Reservoirs
Name | Altitude | Capacity Gallons
Pilarcitos | 696 | 1 150 000 000
San Andres | 478 | 6 500 000 000
Crystal Springs | 310 | 10 000 000 000
Aggregate | | 17 650 000 000

annual rainfall of 51.7 inches, which yields an average daily supply of 13,304,000 gallons. It is proper here to state, that for the purpose of comparison, 50 per cent. of the rainfall on the watersheds of all the plans considered, has been adopted as the available supply, though the percentage could with propriety and justice be increased to 60 per cent. in this case, from the fact that the watershed on the peninsula, from the influence of prevailing fogs, and consequent dampness and less evaporation, yields a larger percentage of the rainfall than the localities farther inland, still the rule or scale which governs all, has been strictly adhered to here.

By careful measurement, the water flowing into the Pilarcitos and San Andres reservoirs, during the dryest season, was found to be 1,575,000 gallons daily as the minimum supply.

Mountain Lake and Lobos Creek furnish a part of the supplies to the Spring Valley Water Works. The water is conveyed by flume from these sources to the delivery well at the pumping house. The pumping service consists of two condensing expansive engines of 200 horse power each, so arranged as to work in combination or separately. To each engine a double-acting pump is attached, which daily forces through two 10-inch and two 12-inch mains 2,250,000 gallons into upper Russian Hill, lower Russian Hill, and Clay street reservoirs, at an elevation of 300, 140, and 353 feet above city base, respectively.

The buildings and general appointments of these works are considered good, the pumping machinery was found in excellent condition, and working well. The best plan of works, however, for supplying water to a city, should be one entirely on the gravitation principle (the kind which has been recommended), and wholly divested of pumping machinery, thus simplifying the works and lessening first cost and maintenance. The Blue Lakes, the Clear Lake, and the Calaveras Valley sources, would afford head of water and force sufficient at Russian Hill, by simply attaching hose to the water pipes, to extinguish fire without the aid of fire engines.

With the view of enlarging and extending the Spring Valley Water Works, the company propose to annex the watersheds of the Cañada Raymundo, embracing 22½ square miles, a part of which is now occupied, and on the site work is commenced, preparatory to building the Crystal Springs reservoir. This reservoir when built will have an elevation of 310 feet above base, and a capacity of 40,000,000,000 gallons.

The present storage capacity of all the reservoirs connected with the Spring Valley Water Works, without the city, is 5,700,000,000 gallons, and within the city as follows: Upper Russian Hill, 3,750,000, elevation 300 feet; Lower Russian Hill, 6,750,000, elevation 140 feet; Market street reservoir 2,250,000, elevation 200 feet; Clay street tank, 140,000, elevation 353 feet; Brannan street, 400,000, elevation 85 feet; College Hill reservoir, 15,000,000, elevation 255 feet; Laguna Honda, 33,000,000, elevation 377 feet, which constitutes an aggregate storage of 5,771,290,000 gallons. Add to this 40,000,000,000 gallons, the capacity of the proposed Crystal Springs reservoir, and it gives a prospec-

tive total of 45,771,290,000 gallons. The available supply under the present condition of the works is 20,714,000 gallons daily; to which also add the probable future condition of the works, by the annexation of the Cañada Raymundo watershed, on which falls annually 34 inches of rain, supplying Crystal Springs reservoir, which would yield, on the basis of the 50 per cent. co-efficient of availability 6.647,000,000 gallons per annum, and the whole would thus yield a total of 36,655,000 gallons daily.

The 20,714,000 gallons, present availability of the works as here shown, is not the quantity found daily flowing from the reservoirs to the city, the latter being only the quantity which is furnished the consumer of water, the rest remains stored in the several reservoirs. How much more supply and storage the company propose to acquire, if any, by the extension and enlargement of their works on the Peninsula, has not transpired, but if all that is available were collected and utilized, it is obvious that the quantity would be large. Still on the gravitation plan of works, it would not answer as a supply to the upper portion of the city, from want of head, and would render pumping service necessary. This, if possible, should be avoided, as it involves a mixed and more expensive system of supply than gravitation works, such as the Clear Lake, Blue Lakes, and Calaveras Valley sources would furnish. With regard to the quality of water collected from the catchment and sources of the Spring Valley Water Company, it is sufficient to say that it is derived from rainfall flowing over an unobjectionable watershed.

WATER SOURCES AND ROUTES TO THE CITY.

Lock's Creek.—Commencing at Lock's Creek, which has a watershed of 1,800 acres, at an elevation of 505 feet above base, and a mean annual rainfall of 58 inches, furnishing a supply of 3,883,435 gallons daily. The water from the creek is conveyed by alternate flumes, syphons and a conduit, a distance of 17.42 miles to San Andres reservoir, there being some 800,000 gallons daily running to waste, which may yet be utilized.

Lake Pilarcitos.—The water of Lake Pilarcitos is conveyed to Laguna Honda reservoir in San Francisco by means of the following detailed structures:

Lake tapped by tunnel No 1	1,550	feet.
Thence into sand-box and waste-gate	280	"
" " tunnel No. 2	3,420	"
" by flume	3,000	"
" by conduit	67,636	"
" by flume	5,300	"
" by conduit	900	"
" by tunnel	2,900	"
" by conduit	800	"

to Laguna Honda reservoir; thence by 22-inch main 3 miles, to head of Market street; thence by 16-inch main 2½ miles to upper Russian Hill reservoir.

Aggregate length of tunnels	7,870 feet.	1.49 miles.
Aggregate length of flumes	8,580 feet.	1.62 miles.
Aggregate length of conduit	69,336 feet.	13.13 miles.
Total distance to Laguna Honda	85,786 feet.	16.24 miles.

PILARCITOS SIDE FLUME.—The side flume of Lake Pilarcitos has a watershed of two square miles, with mean annual rainfall of 54 inches, giving a daily available supply of 2,571,102 gallons—the water being collected from the various streams and brooks in said watershed and thence conveyed by flume (3 feet by 1 foot), 5 miles long, into Lake Pilarcitos.

LAKE SAN ANDRES.—Has a watershed of 4.09 square miles, with mean annual rainfall (average of five years) of 45 inches, giving a daily available supply of 4,285,169 gallons. The water of San Andres is conveyed to College Hill reservoir in San Francisco by the following means: by tunnel, (with gate and shaft) 250 feet; thence by tunnel to sand and screen box, 2,820 feet; thence by 30-inch main to College Hill reservoir 64,000 feet; thence by 22-inch main to Market and Potter streets, 18,480 feet; thence by 16-inch main to Market street reservoir.

Aggregate length of tunnels	3,070 feet.	0.58 miles.
Aggregate length of conduit	82,480 feet.	15.62 miles.
Total length	85,550 feet.	16.20 miles.

The auxiliary feeders of San Andres comprise the following sources, viz: Lock's Creek, San Mateo Creek and Lower Pilarcitos.

LOCKS CREEK.—The water of Lock's Creek is conveyed into San Andres reservoir,

By an initial tunnel		3,200 feet.	0.60 miles.
Aggregate length of flume	occurring alternately.	73,040 "	13.83 "
" " of conduit		15,818 "	2.99 "
Total		92,058 feet.	17.42 miles.

The initial tunnel above mentioned conveys also waste water from Lake Pilarcitos into San Andres reservoir. The surplus water which the capacity of this tunnel will not admit, will find its way by natural channel, to the Crystal Springs reservoir, elsewhere spoken of.

SAN MATEO CREEK.—Has a watershed of 2½ square miles, with a mean annual rainfall of 54 inches, giving a daily available supply of 3,213,827 gallons. The water is conveyed by a flume (6 feet by 2½ feet) 600 feet; thence by Pilarcitos tunnel No. 2, 3,420 feet; thence by 22-inch main 6,000 feet, thence by 4-foot flume 4,000 feet, into Lake San Andres. In case of a flow of water in excess of the capacity of this main and flume, provision has been made to carry such excess, by other mains to San Andres, the aggregate capacity of the mains being 44,000,000 gallons per day.

Lower Pilarcitos has a water shed of 1½ square miles, with a mean annual rainfall of 54 inches, giving a daily available supply of 1,928,327 gallons. The water of Lower Pilarcitos, as well as the waste of Upper Pilarcitos, are conveyed by flume (5 feet by 3 feet), 4,300 feet into Lock's Creek tunnel, thence into Lake San Andres, as described.

San Andres Valley, daily supply	4,285,169 gallons.
Lock's Creek, daily supply	3,083,435 gallons.
San Mateo Creek, daily supply	3,213,827 gallons.
Lower Pilarcitos, daily supply	1,928,327 gallons.
Total daily supply from San Andres reservoir	12,510,758 gallons.

Mountain Lake and Lobos Creek.—These sources are found near Presidio Reservation in San Francisco, and yield 2,250,000 gallons daily. The water is delivered by flume to point Lobos Pumps, thence forced through two 12-inch and two 10-inch mains into the several reservoirs, viz: Lower Russian Hill, Upper Russian Hill, or Clay street tank.

To make explorations, surveys and estimates preparatory to the building of water works, with the way clear, and a wide and unoccupied field to operate in, and select sites from, is comparatively an easy matter, but not so with regard to works such as the Spring Valley Water Works, already built and in operation; here difficulties are encountered not easily overcome. Concerning these works, careful inspection and inquiry was instituted, but nothing of their whole construction excepting the exterior, exposed to view, could be examined. The whole internal arrangements, such as details of reservoirs, foundations, superstructures, pipe system, &c., &c., from being in use and covered by water, or hidden under ground, precluded the possibility of a critical investigation, upon which correct estimates of cost could be predicated. To accomplish that end access to the books and accounts of the Company became necessary. A statement of the case was made to the President, Charles Webb Howard, Esq., which resulted in his readily granting the privilege desired. The intricacies of book-keeping, not familiar to an engineer, rendered it necessary to engage the services of an expert. Solon Pattee, Esq., well-known for his ability as an accountant, was employed, who examined the books of the Company and found that the expenditures for franchises, construction and maintenance had been $8,746,928.12, which is represented by the following schedule of property.

PROPERTY SITUATED IN SAN MATEO COUNTY.

Lake Pilarcitos property, including lake	5,334 acres.
Lake San Andres property, including lake	1,500 acres.
Locks Creek property, including lake	1,150 acres.
Cañada Raymundo, including Crystal Springs reservoir	4,052 acres.
	12,036 acres.

PROPERTY IN SAN FRANCISCO.

1 50-vara lot No. 3, Block 37, N. E. corner Van Ness avenue and Beach street; held for right of way.

1 50-vara lot No. 4, Block 38, S. E. corner Van Ness avenue and Beach street; held for right of way.

3 50-vara lots Nos. 2, 3, and 4, Block 29, N. E. corner of Polk and Chestnut streets; held for right of way.

1 50-vara lot No. 6, Block 28, S. W. corner Chestnut and Larkin streets; held for right of way.

1 50-vara lot No. 804, N. E. corner Lombard and Larkin streets; held for right of way.

9 50-vara lots Nos, 955, 1,344, 1,251, 1,434, 1,345, 1,252, 1,435, 1,346, and 1,160, bounded by Hyde, Larkin, Chestnut, and Bay streets; held for lower Russian Hill reservoir.

6 50-vara lots Nos. 776, 777, 778, 779, 780, and 781, bounded by Greenwich, Lombard, Hyde, and Larkin streets; held for upper Russian Hill reservoir.

7 50-vara lots, block bounded by Kate, Church, Buchanan, Market, and Ridley streets; held for Market street reservoir.

½ 50-vara lot in centre of block bounded by Clay, Washington, Leavenworth, and Jones streets; held for Clay street tank.

4½ 50-vara lots in block bounded by Sixteenth, Seventeenth, Jersey streets, and Potrero avenue; held for Brannan street reservoir.

23 by 137½ feet on north side of California, between Kearny and Montgomery streets; held for Company's office.

Laguna Honda property, 63 acres.

College Hill reservoir property, 8.22 acres.

Mountain Lake and Lobos Creek property, 52.5 acres.

The cost of construction of the reservoirs, flumes, conduits, and all appliances for conveying the water supplied from the sources owned and controlled by the Spring Valley Water Company, as described above, are included in the estimate furnished by Mr. Pattee. Also, the distribution system in the city, which consists of 15 miles of 3-inch pipe, 4½ miles of 4-inch pipe, 43½ miles 6-inch pipe, 25 miles 8 inch pipe, 2¼ miles 10-inch pipe, 11¼ miles 12-inch, 4½ miles 16-inch pipe, ¼ mile 20-inch pipe, and 1¾ miles 22-inch pipe, or a total of 145 miles of pipe, with the appurtenances and attachments thereto belonging.

PESCADERO CREEK.

Pescadero Creek takes its rise in the Santa Cruz range of mountains in San Mateo County, and flows westwardly through a densely wooded country with very abrupt slopes, to the ocean. It is proposed to divert its waters, at a point

about one-fourth of a mile below Peters' Fork, where an embankment 90 feet in height, thrown across Pescadero Creek, will raise the water to an elevation of 410 feet above the city base, and form a reservoir with a capacity of 600,000,000 gallons.

From this reservoir the water is to be conveyed to the main storage reservoir in the Cañada Raymundo, by means of an aqueduct and tunnel along the route of which the head-waters of San Gregorio, Bogas Alamo, and Tunitas Creeks, will be taken up.

The fall of the aqueduct will be 2.27 feet per mile, and its length 22 miles, consisting of 5¾ miles of open canal and 15¼ miles of tunneling.

The diameter of the tunnels will be 10 feet in the clear, lined with brick; the canal 9 feet wide at the bottom, 21 feet at the top, and 6 feet in depth. These, when full, will convey 125,000,000 gallons in 24 hours.

The Cañada Raymundo is situated about two miles southeast of the old Crystal Springs Hotel, and forms the main southerly fork of San Mateo Creek. The height of the proposed reservoir is to be 340 feet above city base, and the greatest height of embankment 129 feet. The capacity of this reservoir is more than sufficient to store all the waters that can be brought through the aqueduct, and the waters flowing into it from its own watershed of 18 square miles.

From this main storage reservoir the water is to be conveyed to distributing reservoirs in the city in a wrought-iron conduit, 55 inches in diameter, with a carrying capacity of 30,000,000 gallons in 24 hours. Length of conduit 18.21 miles, with a total head of 50 feet. Two distributing reservoirs have been located near San Miguel station, at an elevation of 250 feet above city base, with an aggregate capacity of 86,000,000 gallons, and are intended for the low-service supply only, that is, for that part of the city lying below an elevation of 200 feet.

The Supply.—The minimum discharge of Pescadero Creek at the site of the embankment, as determined by weir measurements made in January last, was 2,434,120 gallons, and of San Gregorio creek, its principal tributary, 1,415,200 gallons in 24 hours. This was after a drouth of six weeks, and may be considered a fair average for the summer months. No measurements were made of the other creeks along the route of the aqueduct, but by comparison with the Pescadero and San Gregorio, based upon their respective watersheds, we arrive at a close estimate of their daily discharge, and obtain the following results:

Pescadero Creek	2,434,100 gallons.
San Gregorio Creek	1,415,200 gallons.
Bogas and Alamo Creeks	486,800 gallons.
Tunitas Creek	486,800 gallons.
Total minimum daily supply	4,822,900 gallons.

The discharge of these creeks during, and immediately after, a heavy rain is largely in excess of the carrying capacity of the aqueduct, and owing to the steep slopes and the absence of sites for storage resorvoirs along the route, by far the greater portion of the storm waters must necessarily run to waste and be lost. Without a series of systematic observations on the rainfall and the resulting discharge, extending over at least one entire season, no reliable estimate of the amount that can be intercepted by the aqueduct can be made.

At all events it may be assumed that the aqueduct will run to its full capacity—that is 125,000,000 gallons in twenty-four hours—during a rain, and for a few hours thereafter. There are, on an average, 62 rainy days in the year, which will therefore furnish an aggregate of 7,750,000,000 gallons.

During the remainder of the year the daily supply will vary from 125,000,000 to 5,000,000, but for eight months of the year not more than an average of 5,000,000 gallons per day may be relied upon.

The watershed pertaining to the Cañada Raymundo reservoir, comprises an area of 18 square miles, and will furnish an additional average supply of about 15,000,000 gallons per day.

It will be observed that part of the water shed and reservoir site claimed by the Spring Valley Water Company, comprising the lands and streams (or a considerable portion of them) lying within the limits of the Canada Raymundo, are also claimed by the parties interested in the Pescadero scheme, which conflict of title may in some manner be reconciled by the parties in interest. But the question of title or legal rights of corporations or individuals are matters we do not propose to discuss or settle here. It is simply proposed to state how much water each designated source will supply, where it is to be found, and what it will cost to erect works to utilize it. Nothing more.

The estimates made exhibit the cost of building works deriving their supply from the sources of the Pescadero and intermediate streams. The catchment and streams below the line of tunnel will continue to shed large quantities of water to waste, until provision is made to collect and store it. This may be accomplished by means of an intercepting canal and storage reservoir located at a slight elevation above base, near the ocean coast, from which the water may be elevated, by powerful pumping engines, to supply some one of the reservoirs on the easterly slope of the Peninsula. It is evident that to effect the perfect utilization of the waters of the Peninsula, pumping machinery must ultimately be brought into requisition.

PESCADERO CREEK—ESTIMATE OF COST.

RESERVOIRS.

223,000 Cubic yards embankment for Pescadero reservoir, at 40 cts,	$89,200
142,000 Cubic yards embankment for San Miguel reservoir, at 40 cts.	56,800
1,036,000 Cubic yards embankment for Cañada Raymundo reservoir, at 40 cts	414,400
462,950 Square feet paving for reservoir embankments, at 10 cts	46,295
650 Acres grubbing and clearing, at $30	19,500

12.31 Miles fencing around Pescadero and Cañada Raymundo reservoirs, at $600	7,386	
4,135 Feet fencing around San Miguel reservoir (painted), at $1	4,135	
		$637,716
CANALS.		
120,000 Cubic yards earth excavation on canal, at 15 cts	$18,000	
160,000 Cubic yards loose rock excavation on canal, at 30 cts	48,000	
40,000 Cubic yards hard rock excavation on canal, at 75 cts	30,000	
		96,000
TUNNELS.		
80,520 Lineal feet of tunneling, at $16	$1,288,320	
41,065,000 Brick for lining tunnels, at $30 per M, laid	1,231,950	
5 Timber dams, at $1,750	8,750	
		2,529,020
CONDUIT.		
5,710 Tons of wrought iron for 96,154 lineal feet of conduit, at $120	$685,200	
Making and dipping the conduit 96,154 feet, at $250	240,385	
Trenching and back-filling for conduit 96,154 feet, at 40 cts.	38,461	
4 Water gates, at $4,000	16,000	
		980,046
DISTRIBUTION.		
65,000 Cubic yards embankment for Islais Creek reservoir, at 40 cts	$26,000	
33,800 Square feet paving on embankment, at 10 cts	3,380	
1 Waste pipe	696	
2,145 lineal feet of picket fence painted, at $1	2,145	
Effluent pipes and valves	9,138	
City distribution, low service	1,121,338	
		1,162,697
		$5,405,479
Add 10 per cent. for engineering and contingencies		540,548
Total cost of Pescadero scheme		$5,946,027

DISTRIBUTION.

DISTRIBUTING RESERVOIR FOR HIGH SERVICE.

This reservoir would be used for receiving and distributing the water brought to the city through the conduits from distant places. One of these would occupy the highest available site within the city, at the head of Rock creek, where the supply from the Blue Lakes, Clear Lake and Calaveras Valley sources would be delivered.

This reservoir stands in common to each of these schemes, and has an elevation of 450 feet above base, and a capacity of 247,760,000 gallons. The water would be drawn in larger or smaller quantities to meet the demands of the population, through two 40-inch mains, connecting with the pipe system for distributing water throughout the city, at high elevations.

DISTRIBUTING RESERVOIR FOR LOW SERVICE.

A lower reservoir, disconnected from the first, would occupy a site at the head of Islais creek, to the east of the San Jose Railroad, at an elevation of

250 feet above the base of levels, and have a capacity of 16,000,000 gallons. It would receive its supply for distribution from a conduit extending to and connecting with the Pescadero source of supply. This reservoir should be considered apart from (although it might have pipe communication with) any proposed plan for Laguna Merced, or Spring Valley Water Works reservoir, and be used in common to supply the lower level of the city.

PIPE SYSTEM.

The pipe system for distributing water through the streets, alleys and public grounds of the city, will derive its supply from the two reservoirs above described, and be divided into an upper and lower service, having suitable attachments to open and close a connection between them at pleasure. For the most part this communication will be closed, to open only in the contingency of fire, or in the event of accident, which from any cause may interrupt the supply of water to the lower service. This separation of the two services becomes especially necessary, owing to the head from the upper reservoir—450 feet above sea level—being too great for the lower service to bear under constant use. The upper service would receive its supply of water from the higher reservoir for distribution in all localities at and over 200 feet above tide ; and the lower service for distribution receive its supply from the lower reservoir 250 feet above tide ; the lower distributing pipes to extend from sea level to the aforesaid connection of the two services.

To make this water supply a popular, as well as remunerative measure, at least so far as to avoid a direct tax for its support, the necessity of extending the pipe lines as far as possible, should be kept in view, that the benefits and security from water supply may be felt by all.

It is comparatively easy to compute the cost of water works, of any given capacity and extent, but not so of the revenue to be derived from them, as it is impossible to foresee how generally the citizens will take the water, or what price it will command. A safe estimate of the net earnings may be made by comparison with the rates at which other cities furnish water. It is a bad policy to curtail the water pipe extension for the purpose of lessening the first cost, as this is cutting off the revenue of the works which supports them, without taxing those situated beyond the limits of supply. While an exact revenue from the works cannot be determined, it would be a satisfaction to the citizens to know, that by building and owning their own works, and after defraying the expense of maintenance and setting aside an amount sufficient as a sinking fund to pay the principal and interest, they would get the water at cost.

PIPE DISTRIBUTION.

The two services, upper and lower, before described, will start from effluent chambers, constructed in the bottom of the respective reservoirs; and through the embankment of each reservoir there will extend the before mentioned two mains of 40 inches diameter, and 1,000 feet in length, each terminated with a water-gate; one of these, for the present, at each reservoir, to be connected

by means of a reducer, with a main 30 inches diameter, for conveying the water to the city for distribution, and the other to be held in reserve for future use.

The 30-inch main, in the upper service, will extend from the connection with the 40-inch main along Diamond street to Seventeenth; thence to Castro; to Ridley; to Devisadero; to Jackson; to corner of Jackson and Jones streets; the total length being 21,400 feet, or about 4 miles.

The 30-inch main in the lower service will extend from the 40-inch connection along old San Jose Road to Valencia street; thence to corner of Valencia and Market; the total length being 24,500 feet, or 4.6 miles, and here the communicating pipe between the systems is connected, and extends along Market street to its junction with the 30-inch of the upper service. A watergate in this connecting line, operated at pleasure, opens a communication between the upper and lower service as described; these form the principal arteries of supply, and the rest of the pipes of different diameters and extent for distribution through the city, would be laid in the following order:

MAINS AND DISTRIBUTING PIPES.

Supply main from high and low service reservoirs to city, 30 inches diameter, 8.693 miles long, 7,272.63 tons, at $74.436	$541,345 00
Distributing main, 20 inches diameter, 4.564 miles long, 2,133 tons, at $74.865	159,694 00
Distributing main, 16 inches diameter, 2.879 miles long, 912.65 tons, at $75.438	68,851 00
Distributing main, 10 inches diameter, 2.083 miles long, 423.83 tons, at $75.416	31,964 00
Distributing pipe, 8 inches diameter, 16.098 miles long, 2,153 tons, at $76.455	164,611 00
Distributing pipe, 6 inches diameter, 29.148 miles long, 2,977 tons, at $76.43	227,557 00
Distributing pipe, 4 inches diameter, 94.015 miles long, 5,050.87 tons, at $78.38	395,879 00
	$1,589,901 00

STOP VALVES.

8 30-inch stop valves for supply main, at $900	$7,200 00	
10 20-inch stop valves for distributing main, at $400	4,000 00	
16 16-inch stop valves for distributing main, at $250	4,000 00	
8 10-inch stop valves for distributing main, at $90	720 00	
80 8-inch stop valves for distributing pipe, at $55	4,400 00	
200 6-inch stop valves for distributing pipe, at $45	9,000 00	
1,300 4-inch stop valves for distributing pipe, at $35	45,000 00	
		74,820 00

VALVE BOXES.

Excavation, 1,622 cubic yards, at 25 cts	$405 50	
3-inch redwood plank, 155 M, at $22.50	3,487 50	
Add for nails and construction	1,743 75	
		5,636 75

SPECIAL CASTINGS.

1,622 Valve covers, 33 tons	
T's Curves, etc....325 tons—358 tons, at $80	28,640 00
	$1,698,997 75
Add 10 per cent. for contingencies	169,899 77
Total cost of distribution	$1,868,897 52

The above estimate for distribution embraces 157½ miles of pipe, and applies to all the schemes for supplying the city embodied in this report, except the Spring Valley Water Works, which has its own pipe system.

SUMMARY OF ESTIMATES.

COMPARATIVE COST.

Blue Lakes	$25,581,414
Clear Lake	22,014,641
Laguna Merced	2,223,177
Calaveras Valley	10,655,052
Spring Valley Water Works	8,746,928
Pescadero Creek	5,946,027

RECOMMENDATION.

These investigations, as understood and aimed to be carried out by your engineer, are intended as an inquiry to ascertain by what method the cheapest and best water works could, by purchase or by building, be provided, owned, and controlled by the city.

The question of water supply alone, irrespective of ownership, or the interest of individuals or corporations, has been considered, and the facts in the case reported in plain but respectful terms, leaving the main question, that of purchasing or building works, as the case may be, to be determined by your Honorable Board.

After careful examination, computation, and comparison of the different plans of works, your engineer has selected and respectfully recommends the adoption of that plan which will derive its supply from the Calaveras Valley and sources, for the following reasons, namely:

First.—Because works built on this plan would meet every requirement to furnish 100 gallons of water per diem to each inhabitant of a population of 500,000, or 50,000,000 gallons delivered at the city every 24 hours.

Second.—Because these works require no canal or ditch, no syphons or pipe inverts, to carry water from one point to another under cañons or valleys, no flumes of wood (to decay and be removed) to pass precipitous places of difficult access and repair, nor any expensive cuts of earth or stone, nor work exposed to hillside slides, to carry it away and interrupt the supply of water, nor walls of masonry, or trestle of timber to retain, protect, or support the water channel, conduit, or flume, but which obtain in all other plans to a greater or less extent.

Third.—Because no portion of the conduit is rendered inaccessible by passing under river or bay, or subject to the action of salt water and corrosion to hasten its destruction; but it presents a direct, unbroken, and well protected line from end to end, extending along a comparatively level country, close to a public highway, with a railroad accessible at every point, so that in the event of accident a large force of men and necessary materials and implements could be concentrated in a given time, to dispatch repairs, than by any other plan.

Fourth.—Because only one reservoir without the city, of unquestionable capacity, instead of many, is required, from which, owing to its great depth, capacity, and limited water surface, there will be less loss by evaporation than from the several reservoirs connected with each of the other systems.

Fifth.—Because the works suggested (as also the Blue Lakes and Clear Lake plans) would flow the water by gravitation alone, and consequently without the necessity of pumping machinery, at least 100 feet higher than Russian Hill, or than is now supplied, and it is in all other respects the best and simplest system of works and less liable to get out of order than any other.

The single consideration of the conduit passing around, instead of under, the bay, is of the utmost importance, thus avoiding a complex and inaccessible adjunct, requiring pipe with flexible or compound joints, very difficult and expensive to lay, and always imperiled, in whatever manner laid, by presenting an obstacle to the anchorage of the bay, and its valuable uses as a harbor, as which it should be guarded with great care, as also should the supply of water to a city be guarded from interruption by accident, to which it would be liable by laying the conduit under the bay.

With reference to the Calaveras, Clear Lake, and Pescadero schemes, the point likely to attract most attention lies in the unusual height of the dam to be built across the narrow gap or cañon which forms the outlet of the Calaveras valley, in one case, being 196 feet high; and that built across the valley which is to form the Carquinez reservoir being 189 feet high; in another case, and lastly, that across the Pescadero, being 95 feet high.

Some writers have ventured to fix a limit to the height of dams or embankments for retaining water, to exceed which, they affirm, would endanger the structure. It is admitted that heavy dams with straight, rigid, iron outlet pipes laid in them when built, while undergoing the slow but irresistible process of settling, to which they are subjected for a long period of years, bend the pipes, and this starts leaks at the joints, or perhaps fractures the pipes, and by the consequent escape of water under pressure which follows, finally softens and destroys the structure. Heavy dams are more liable to accident from this cause than lighter ones; but the principle does not apply to all heavy dams, and especially to any of the cases in question, as the outlet pipes are severally conducted through the side of the reservoir or natural embankment, where the load will be comparatively light, and no possibility of settling.

To entirely obviate the difficulty, the outlet for the Calaveras reservoir will be a tunnel, cut through a ridge of solid rock, and to this tunnel the conduit to carry water to the city, will be attached.

Because a few badly constructed, and therefore insufficient and weak dams have failed in the past, which are the exception and not the rule, it should not be inferred from these failures, and the disasters attending them, that a perfectly built and properly placed dam, such as the one under consideration, would fail. It would be inconsistent to hold that because an improperly built bridge fails that all bridges would fail, and should therefore be condemned.

If it were proposed to build at the narrow cañon or outlet of the Calaveras valley or the wider one at the Carquinez valley, a dam, for instance, one mile wide to resist the pressure of water 191 feet deep, the absurdity of such a proposition would strike the common sense of every man; if the width then were reduced to even half a mile it would appear equally ridiculous. How much less than half a mile it would do to make the width of the dam to withstand the pressure of water against it with safety, is the province of an engineer to determine.

If a dam of 50 feet or more in height has been built and used, as has been with safety, why not build and use a dam 100 feet or 200 feet or even more, in height, if required, with safety. To say that dams are limited to given heights, beyond which they cannot be built, is to say that the skill of engineering is prescribed to this limit, and this is absurd. We see instances among the mountain reservoirs or lakes, of dams or natural embankments sustaining a head of 500 to 1,000 feet, or more.

The public are licensed to speculate on disasters, and the causes attending the failures of structures of all kinds, and condemn them with impunity; but it is hazardous for an engineer to do so. It is no compliment to the profession to which he belongs to reject any untried and apparently feasible project (in this enlightened and progressive age), or say that he cannot do anything that is possible, and it would be humiliating to confess his inability to build a safe and strong dam, at any of the places mentioned.

In conclusion, it is proper to state that the selection and recommendation of the plan of works proposed should not be construed in disparagement or in condemnation of other plans for purposes of water supply, as their merits are only treated comparatively. No one more highly appreciates the value and importance of the different plans submitted to your Engineer than he does, as water schemes, to be brought in requisition at later periods, or when the sources on the peninsula (which includes those of the Spring Valley Water Co.) and the Calaveras fail to supply the city with sufficient water. They are also valuable for purposes of irrigation, to which they might be applied with great success and profit.

Believing it is best to secure and utilize all the sources of supply by gravitation on the peninsula after that of the Calaveras, I do not hesitate to recomemend for your adoption all these supplies, commencing at the city and extending to and including the Pescadero.

There undoubtedly can be found more than enough water, if properly collected and husbanded, from the sources above recommended, to furnish San Francisco with water for every useful purpose, to and beyond the close of the present century; when, after this period, it may reasonably be supposed that your city will have a population of more than a million of inhabitants, and increasing rapidly, it will become necessary to consider from what source beyond the peninsula and the Calaveras an additional supply of water can be obtained.

There are cogent reasons for adopting the sources above recommended, not only those arising from economy of cost and maintenance of works close at hand, but as a means of public security against external disturbances; such as were witnessed by your engineer during the late civil war, when the army of the South threatened destruction to the Cincinnati and Louisville Water Works. As a case in point, a plan submitted by your engineer for the enlargement and extension of the Cincinnati Water Works, having their source of supply in the State of Kentucky, was rejected, and a plan for water supply, the source of which was within the State of Ohio, was adopted for the reason recited above, although at least doubling the cost of construction.

There is no foreseeing the dissensions that may sever the State, and leave remote water sources without her boundary and beyond her control; or what invading army may in time of war, in a spirit of vandalism, destroy her lengthy conduits, cut off the supply of water, and inflict upon San Francisco the greatest calamity that could befall a city. Hence the necessity that may be deemed absolute in providing a plentiful supply of water near at hand to guard against any possible contingency.

These are some of the considerations which have influenced your engineer in selecting the plans of works recommended to your Honorable Body.

For the purpose of comparing the different schemes by the same standard, the full size of a single line of pipe (of sheet or plate iron rivited) to deliver 50,000,000 gallons of water daily from the sources to the city, has been adopted. In practice, however, it would be better to commence with one conduit to deliver half that quantity, and add the other when required. The cost would be somewhat greater, but the plan would have the compensating advantage of a duplicate to furnish a partial supply from one conduit in the event of an accident to the other.

The wrought plate conduits and invert syphons proposed for the several schemes, (and so commonly used in California for water works and mining purposes, with uniform success and satisfaction) should be made of iron of the highest grade and tensile strength, tested at fully 55,000 lbs. to the sectional square inch, the thickness to increase or diminish with varying head or pressure. In the foregoing estimates the thickness was computed at double the thickness at which it would be torn asunder. Considering the action of the elements inducing corrosion and wear, as also the strain from shocks to which all water pipes are subjected, it was not deemed advisable or safe to reduce this standard of thickness. Instead of less, it should for perfect

safety and durability be more, but as iron enters largely into the construction of these works, this item has from motives of economy, both in respect to diameter and thickness, been estimated as close to the limit of safety and capacity as possible.

The Contingency of Fire Considered.—San Francisco has had her conflagrations; she may have another; the same cause is likely to produce the same effect. The next conflagration may prove to be more disastrous than the last, or like that at Chicago, especially if fire should happen during an interruption to the supply of water (the danger to which could be made less imminent by adopting a simple plan of works, having its source near by and fewer contingencies of accident), with a fierce gale of wind, if no longer than for a single hour, it would spread beyond control, and the whole city soon laid in ashes. To restore it from such ruins, to say nothing of the destitution, and the suffering thousands rendered homeless thereby, the expense would probably exceed millions, many times told, the cost of building reliable and efficient works, that would drench the city with water at a moment's notice.

The sanitary question, in connection with the water supply, is one of vital importance to San Francisco. It is one that deserves the serious attention of the citizens, and would well repay the city to appoint a special commission, including the highest medical authority in the country, to thoroughly investigate and treat it at length. Districts abounding with malaria arising from stagnant pools and bad drainage, and which are known to be the prolific cause of intermittent and typhoid fevers, and other malignant diseases, need examination. Also, sewerage, a subject of great importance and of such intimate relation to water supply in its sanitary bearing, that the omission of one would render the other futile.

We cannot, of course, here enter into the details or elaboration of a general plan of drainage for the city, as it is, when fully treated, the subject of a very lengthy report. As a preparatory step, however, a thorough system of levels should be established, showing street intersections by profiles and town plats, and accurate contour lines starting from a given base. The report should embody information with regard to the shape and capacity of the various drains or sewers required for an entire system of drainage, as well as the materials to be used in their construction; also, explanations with regard to necessary foundations adapted to the different natural and artificial foundations through which this system of drains and sewers may pass. Also, to add the most approved contrivances in use (as demonstrated by practical experience), such as gully gratings, stench traps, house drains, sewer ventilation, and sluice-gates, including specifications, and all useful information necessary for constructing any part of the work; the whole to be submitted to the proper authorities for approval, before any of the work should be contracted for or allowed to be built.

The systems of water supply and sewerage combined should ultimately be conducted by one Board of Control, as they are almost inseparable, and equally conducive to comfort and health, and mutually efficacious in the removal of filth and foul emanations from sewerage, one of the most unwhole-

some elements of diseases in any city, and this removal would afford the advantage of cleanliness to every person and habitation. These are means of public purification, supplying pure air and water in abundance, and there is no reason why San Francisco, with plenty of water and proper attention to her sanitary condition, should not be one of the most healthy cities in the world.

An inestimable benefit would be conferred by showering water plenteously upon the streets and alleys of the city, and abate a great public nuisance in laying the dust; and when thrown unsparingly on the gardens, lawns, and public grounds, and thrown in jets and spray from fountains, as it should be, would give the city a bright and cheerful appearance, and render the air pure and refreshing.

The salutary influence of water would not only tend to promote the comfort and enjoyment of the citizens and diminish disease, but it would lessen mortality: matters far beyond any consideration of money when so easily procured. Aside, however, from the foregoing considerations, as a measure of economy it would be sensibly felt; the risk and premium on insurance against fire would be lessened, and thus reduce a burdensome tax; property anywhere in the city limits would be enhanced in value, as it invariably is where water pipes are laid, so that the advantage derived, when well considered, would be found fully commensurate with the cost.

Another great advantage will be derived from the profuse supply of water under pressure, by furnishing motive power for driving printing presses, the use of elevators, and workshops, in short, for driving all light machinery at less cost than coal alone to produce the same results, and this without the danger of fire or explosion. Afterwards the same water remaining pure may be utilized for other purposes.

A city built of light, combustible material and exposed to the high winds that prevail in San Francisco, should be provided with ample means for speedy and effective extinguishment of fire. To that end a well distributed system of street or underground cisterns, of 10,000 or 20,000 gallons capacity each, connected with the water pipes and constantly kept full, should be established throughout the city; and be under the immediate control of the Chief of the Fire Department. Instead of drawing all the water from fire plugs, four fire engines may be located at right angles around one of these cisterns, and four around another, and so on until every engine in the service may center its hose and jets on a single fire (street mains discharging their full capacity into the reservoirs), and thus with amazing execution and dispatch, quench the flames. When fire obtains the mastery, the efforts of the Fire Department become futile; hence the necessity of extending the fostering aid of the authorities by providing every useful device to perfect the system referred to, and strengthen the already efficient Fire Department, of which San Francisco has every reason to be proud.

Respectfully submitted,

T. R. SCOWDEN,

Chief Engineer City Water Supply.

San Francisco, Cal., April 19th, 1875.

APPENDIX.

No. 2,371. STATE ASSAY OFFICE, 421 MONTGOMERY STREET, SAN FRANCISCO, April 5th, 1875.

Report of Technical Analyses of seven samples of water received from T. R. Scowden, Esq., Chief Engineer City Water Supply.

WHERE FROM.	Total of fixed Ingredients.		I Precipitated on exposure to atmosphere at ordinary temperature.		II. Precipitated upon partial evaporation as in steam boilers.		III. Remaining in Solution.	
	PARTS IN 100.000	GRAINS PER GALLON.	PARTS IN 100.000	GRAINS PER GALLON.	PARTS IN 100.000	GRAINS PER GALLON.	PARTS IN 100.000	GRAINS PER GALLON.
Laguna Merced.....	39.40	27.58	9.23	6.461	15.92	11.144	14.25	9.975
Spring Valley.....	26.60	18.62	6.45	4.515	13.95	9.765	6.20	4.340
Blue Lakes.....	21.	14.70	1.66	1.162	17.24	12.68	2.10	1.470
Clear Lake.....	26.	18.20	12.75	8.925	10.75	7.525	2.50	1.750
Clear L.—Putas Creek	16.60	11.62	8.5	5.950	3.85	2.695	4.70	3.290
Calaveras Creek.....	30.60	21.42	16.20	11.340	13.	9.100	1.40	0.980
Pescadero Creek.....	41.	28.70	20.25	14.175	16.15	11.305	4.60	3.220

Groups I and II comprise the substances which render water hard. I—Consisting principally of carbonates of lime and of magnesia held in solution as bicarbonates. II—Of sulphate of lime (gypsum) with traces of alumina, iron, etc. III—Not precipitable by exposure to the atmosphere or partial evaporation of the water, consists of chloride of sodium and other easily soluble salts.

All the samples naturally contain carbonic acid gas, and more or less organic matter, the latter apparently not of an objectional character. To determine quality and quantity of organic constituents, larger samples would be required.

[Official Seal.] Yours, etc.,

(Signed) LOUIS FALKENAU, State Assayer.

The following, in addition to the preceding report of analyses, may be of interest:

T. R. SCOWDEN, ESQ.,

Chief Engineer City Water Supply:

SIR: In connection with the report of analyses of waters received, I would state some points that might tend to make more clear the practical value of the figures there given. In waters intended for technical and domestic use, the total amount of fixed ingredients may vary from 10 (or less) in 100 parts to every 100,000 parts. The water of the Thames, for instance, contains from 29.69 to 40.84 in every 100,000 parts. The water of London

artesian wells, from 50.06 to 99.15 in 100,000. While the Croton water of New York contains from 6 to 7 parts in 100,000.

These fixed ingredients must not be regarded as impurities, as no natural water, excepting rain water, is entirely without them. Besides rendering the water more palatable, they make it also more wholesome.

The samples analyzed were taken under disadvantageous circumstances, viz.: before the beginning of the rainy season, being the time when they contain, by reason of evaporation during the dry season, a greater amount of fixed ingredients to a given weight of water.

To obtain accurate figures, large samples (about five gallons) should be taken at different seasons, then subjected to full analysis, and an average taken of the results. The samples analyzed by me were too small to allow of exact determination, therefore the results obtained are simply approximate.

(Signed) LOUIS FALKENAU,
State Assayer.

San Francisco, April 12th, 1875.

On the 26th day of April, 1875, the following propositions to bring water from Lake Tahoe, and from the Blue Lakes in Alpine and Calaveras counties, were received, read and referred to the Special Committee on Water Supply :

LAKE TAHOE.

PROPOSITION OF THE LAKE TAHOE AND SAN FRANCISCO WATER WORKS.

To the Honorable the Mayor and Board of Supervisors
of the City and County of San Francisco:

Gentlemen : I am authorized and directed by the Board of Trustees of the Lake Tahoe and San Francisco Water Works to make to your Honorable Body the following proposition, viz :

The said Lake Tahoe and San Francisco Water Works propose to enter into a contract with your Honorable Body to supply to the City and County of San Francisco, from Lake Tahoe, via Auburn, Sacramento, Straits of Carquinez and Oakland, sixty million (60,000,000) gallons of pure fresh water per day, of twenty-four hours; said amount of water to be delivered at an elevation not to exceed three hundred and seventy (370) feet above the city base, in such reservoir as the city may construct for the reception of said supply, for the sum of thirteen millions three hundred and seventy thousand nine hundred and thirty dollars ($13,370,930) in gold bonds of said city and county, payable in forty years; said bonds to bear interest at the rate of six per cent. per annum ; said amount to be paid to said company in the following manner, to-wit : seventy-five per cent. of the contract price as the work progresses, as hereafter mentioned, the balance of the contract price to be paid when the work is completed ; the entire work to be completed within five years from the date of signing the contract.

Said company further proposes that, upon the completion and fulfillment of said contract, it will assign, convey and turn over, for the above mentioned amount, all the works as completed, property and franchises of said company complete in all respects from Lake Tahoe to said City and County of San Francisco, placing the absolute ownership of entire works, rights, franchises and property of said company in said city and county.

Payments by issuance of bonds will be required in about the following proportions, viz :

The first year	$1,000,000
The second year	2,000,000
The third year	3,000,000
The fourth year	4,000,000
The fifth year	3,370,930
Total	$13,370,930

The said Lake Tahoe and San Francisco Water Works is prepared to enter into any reasonable amount of bonds that may be reqnired for the faithful performance of the work proposed, or to make such other arrangements with yonr Honorable Board as shall appear for the best interests of this city.

In connection with this proposition I beg to call your attention to the accompanying report and estimates of the work in detail.

I have the honor to be,

Yours, very respectfully,

A. W. VON SCHMIDT,

President and Chief Engineer of the Lake Tahoe and San Francisco Water Works.

San Francisco, Cal., April 26, 1875.

REPORT.

SOURCES OF SUPPLY.

Lake Tahoe, the main source of supply of the Lake Tahoe and San Francisco Water Works, is located in the Sierra Nevada Mountains, at an elevation of 6,220 feet above the level of the sea, and covers an area of two hundred and forty square miles. Its greatest depth is 1,500 feet.

The quality of the water is probably the purest of any in the world, being produced from melting snows and mountain streams. The surrounding mountains are mostly of granite formation.

The only outlet of the lake is the Truckee River, which flows during the dryest times of the year, in ordinary seasons, 800,000,000 gallons of water per diem, and for some months, during the floods, more than three times that quantity.

To guard against dry seasons, a dam has been constructed by the company, on the Truckee River at the outlet of the lake, with suitable gates, for the purpose of storing the water, by preventing the floods from escaping out of the lake and running to waste, at the same time allowing the necessary amount of water to flow down the Truckee River for the use of mills and manufactories. The lake will fill to the capacity of this dam in one ordinary season.

The quantity of water thus stored will be immense, and will be better understood by stating that one foot of water drawn from this lake in a year will give one hundred and thirty-seven million gallons per day.

The lake will be raised by said dam six feet above low water mark, or about one foot above high water mark; it will then give six times 137,000,000 gallons, or 822,000,000 gallons per diem, without interfering with the natural or ordinary flow of the Truckee River, that is, after the lake is once filled to the height of the dam.

A second dam has been constructed on the Truckee River, at a point three and three-quarters miles below the dam at the lake, at which second dam the water is diverted from the river and taken into a canal.

Independent of the lake, there are several creeks or streams which the company can draw water from during the rainy season, and while the snow is melting in the spring of the year, namely : Bear Creek, Squaw Valley Creek, Deer Creek, and Hardscramble Creek ; all

of these streams are on the east side of the mountains, and are tributaries of the Truckee River below the lake.

On the west side of the Sierras, the company has several tributaries of the American River, which afford quite a large supply of water in the spring and early summer months. It will therefore be understood that water from Lake Tahoe will only be drawn when these streams fail to supply the amount of water required. It is estimated that the company will only require to draw from Lake Tahoe about eight months out of the twelve.

TITLE.

The company's title and ownership to the waters and right of way is acquired and confirmed under and by virtue of the Incorporation Laws of the State of California, and by an Act of Congress of the United States, passed July 26, 1866, entitled "An Act granting the right of way to ditch and canal owners over the public lands, and for other purposes."

LINE OF WORKS.

To make the waters of Lake Tahoe available, the following work is necessary to be done:

The water from the dam at the outlet of the lake will flow down the Truckee River, three and three-quarter miles to the company's second dam on the river, at which point it is diverted from the river into a canal to be constructed six miles long, through which it flows to the entrance of the proposed tunnel at Hardscramble Creek, through the Sierra Nevada Mountains. The tunnel by this Hardscramble Creek route is 26,400 feet, or five miles long. The water from the said canal enters and flows through this tunnel, coming out on the west side of the mountains at a point a short distance above the Soda Springs (so called) on the South Fork of the North Fork of the American River.

Several other routes for a tunnel have been surveyed; that at the head of Cold Stream, surveyed for railroad tunnel, is 24,172 feet long, with an open cut half a mile long, of an average depth of 20 feet. To reach the entrance of this railroad tunnel it would require nine miles more canal on the east side of the mountains, making 15 miles of canal from said second dam to entrance of tunnel or cut. I am therefore of opinion that the Hardscramble route, although longer than some of the other lines, is by far the most preferable. So far as can be seen and judged of, from the surface of the ground, the Hardscramble route is apparently free from granite, the rock appears to be a volcanic stone, called by some cement rock. It works and stands well.

The lines of the company's works from the tunnel will be as follows:

For the supply of towns and cities, the water after leaving the tunnel at or near Soda Springs, on the west side of the mountain, will flow down the granite bed of the American River about 12 miles, where it will be taken from the river and conducted in a suitable canal a distance of about 40 miles, to a point near Auburn, in Placer County, at which point it will enter a reservoir of convenient size, to be constructed for that purpose. Leaving this reservoir the water will enter a large wrought iron pipe, and by that means be conducted to the City of San Francisco, via Sacramento, Fairfield, Vallejo and Oakland.

The canal to Auburn will have capacity to carry 100,000,000 gallons per day. The length of pipe from Auburn to San Francisco will be about one hundred and twenty miles, making the total distance of actual line of works to be constructed to reach San Francisco, one hundred and seventy-one miles.

ESTIMATED COST.

I have estimated the cost of tunnel through the Sierra Nevada Mountains as follows, viz:

Circular tunnel ten feet diameter, with a fall of ten feet to the mile, the contents of which are 78.539 cubic feet to each foot in length—or 2.9 cubic yards to each running foot—the

length of tunnel is 26,400 feet, multiplied by 2.9 gives 76,560 cubic yards, at $10.86¼ per yard, or 26,400 feet at $31.50 per foot, gives	$831,600
Add contingent expenses thereon, say 25 per cent	207,900
Total cost of tunnel	$1,039,500

The cost of ditch or canal I estimate as follows:

East of Sierra Nevada Mountains, six miles at $20,000 per mile	$120,000
West of mountains, forty miles at $20,000 per mile	800,000
	$920,000
Reservoir at Auburn	$100,000

From Auburn to San Francisco, 120 miles, by means of wrought iron boiler plate pipes, averaging one-quarter inch in thickness:

To carry 60,000,000 gallons of water per day of twenty-four hours, and deliver same into a reservoir three hundred and seventy feet above city base, requires a pipe sixty inches, or five feet in diameter, with a fall of ten feet to the mile.

To make one mile of this pipe, it requires 84,480 square feet, which being multiplied by ten pounds to the square foot, gives 844,800 pounds to the mile; this multiplied by 120 miles, makes 101,376,000 pounds, or 50,688 tons, which at 5 cents per pound, or $100 per ton, would be $5,068,800

Rivets, cost of work and laying, $5 per foot, 633,600 feet, at $5	3,168,000
Transportation	100,000
Tunneling Strait of Carquinez	350,000
Crossing Bay of San Francisco	500,000
	$11,246,300
10 per cent. contingent	1,124,630
Franchise and water rights	1,000,000
Total	$13,370,930

RECAPITULATION OF ESTIMATED COST OF LINE OF WORKS FROM LAKE TAHOE TO SAN FRANCISCO.

Cost of tunnel	$1,039,500
6 miles of canal, east of tunnel	120,000
40 miles of canal, west of tunnel	860,000
Reservoir at Auburn	100,000
Pipe from Auburn to San Francisco, 120 miles, 60-inch diameter	8,236,800
Transportation of pipe	100,000
Tunneling Straits of Carquinez	350,000
Crossing Bay of San Francisco	500,000
	$11,246,300
10 per cent. for contingent expenses	1,124,630
Franchise and water rights	1,000,000
	$13,370,930

Respectfully submitted,

A. W. VON SCHMIDT,

Chief Engineer Lake Tahoe and San Francisco Water Works.

San Francisco, Cal., April 22, 1875.

BLUE LAKES.

PROPOSITION OF MR. CLARK.

April 26, 1875.

To J. H. Deering, Esq.,

Chairman of the Committee on Water Supply:

Sir: The report of Col. T. R. Scowden having been submitted to the Board of Supervisors, and the cost of furnishing the city with an abundant supply of good water being, according to his estimate far beyond what was generally anticipated, and far in excess of what other engineers have estimated the probable cost to be, I will, as a friend, and one of the legal advisers of Mr. Clark, who proposed the Blue Lakes of Alpine and Calaveras counties as a source of supply, say in his behalf,

First—That he would not like to compete with city contractors and manufacturers for the job of constructing reservoirs and laying pipe in the city. That work has been estimated by your engineer to cost less than three millions of dollars.

Second—Mr. Clark will, for the sum of twelve millions of dollars, convey to the city all his canals, water-rights, dams, reservoirs, etc., which he now has in Alpine and Calaveras counties. He will also purchase at his own cost all rights of way, all necessary lands for reservoirs, etc., and convey the same to the city, so far as they can be procured without condemnation. Those that have to be condemned by legal proceedings, he will pay for. He will furnish all the necessary reservoirs to hold in storage eighteen billions (French computation) and two hundred and fif y millions of gallons of water (18,250,000,000), or fifty millions a day for one entire year, if there was not a drop of water running more than sufficient to supply evaporation and leakage. He will construct a canal in every respect as described in Col. Scowden's report, capable of carrying one hundred and twenty-five millions of gallons a day. From the end of the canal he will carry the water to the city reservoirs in a pipe of ample strength to last for fifty years without material repairs, and of sufficient capacity to deliver at the reservoir fifty millions of gallons a day. In fine, for this twelve millions of dollars, he will vest in the city a complete title to the necessary water-rights, dams, ditches, aqueducts, reservoirs, pipes, etc., necessary to furnish fifty millions of gallons a day for the present, and capable of being increased at any time to one hundred or two hundred millions a day if desired by the city. In addition to furnishing the city with this water at the price named, he will, for the use of the surplus water in the canal, as long as the city only wants the fifty millions of gallons a day, keep all pipes, dams, reservoirs, aqueducts, etc., outside of the city, in repair at his own expense.

He will agree to have the full supply in the city within three years after the contract is signed.

ADVANTAGES OF THIS OFFER.

To your Committee who visited the north fork of the Mokelumne River and the Blue Lakes last August, I need not say a word about the quantity or quality of the water. I am sure that you, and each of you, would say from your own observation that the quality was equal to any water in the world, and the quantity almost inexhaustible. The interest on the cost of fifty millions of gallons per day of the best quality of water would be only nine hundred thousand dollars a year, about what is paid in water rates for the use of less than ten millions a day of not very good water.

The water comes from mountain streams, which, for seven or eight months of any year, and for twelve months of an ordinary season, would afford an ample supply without storage.

Mr. Clark's scheme embraces the building of one large reservoir at Livermore Pass, and one or more at or near the end of his canal, but the water of these reservoirs would never be used except in case of accident or stoppage of the water above for cleaning or repairing the canal. All the water ordinarily used for city purposes would come from living streams and the lake reservoirs, more than 7,500 feet above the level of the sea where the water,

by means of melting snows, is always kept at a temperature only a little above the freezing point, and never becomes stagnant or offensive to taste, sight or smell. I make the following quotation from your engineer's report as to the quality of water: "The melting snow, varying in depth from 5 to 20 feet, portions of which never wholly disappear, and the copious springs and streams on the watershed, furnish a continual supply of water, which, from its altitude, the geological conformation of the country being sparsely wooded and and limited in soil and vegetation beyond the possibility of agriculture or manufacturing operations, being far above the mineral belt, must remain forever pure."

No one who has seen or tasted this water can doubt its superiority over water caught and stored up after hard rains, which wash from the surface all the offensive matter found on lands in a country extensively pastured, and having many inhabitants. None of Mr. Clark's embankments would be more than thirty to forty feet in height, the danger of breaking would be much less than a dam from 100 to 200 feet high, and if one of his dams did break, the consequences would not be disastrous. The channel of the Mokelumne River would be large enough to carry off the surplus water, if it is deemed unsafe to carry the water pipe across the bay at Ravenswood; for a slight additional cost it could be taken around the head of the bay at Alviso. If these propositions should meet the views of the Board, Mr. Clark would doubtless be willing to enter upon the discussion of the details of the contract, and I believe could satisfy your Honorable Board that he could give sufficient guaranty for the performance of his part of the contract.

Further legislation might be required this winter before the contract could be closed. An Act of Congress ought also to be procured, vesting the absolute ownership of the soil covered by the lakes, reservoirs, etc., in the City of San Francisco.

Respectfully,

H. O. BEATTY.

After the filing of the report of Chief Engineer T. R. Scowden, it was deemed for the public interest by the Committee on Water Supply to give an opportunity to parties who possessed water-right interests to submit propositions in relation to them, with estimates of the cost of the necessary works to convey water from the different sources to the city; in accordance with which Supervisor Deering, on April 26, 1875, introduced a resolution (No. 7,240) which was adopted, inviting all parties owning or interested in water-rights, on or before May 3d, to present estimates and proposals to furnish the city with water, embracing all details as to quantity to be furnished, the cost, length, size and thickness of pipe, together with the time required to complete their works. On May 3d, the following additional propositions were received and referred to the Special Committee on Water Supply:

THE CLEAR LAKE WATER WORKS.

To the Honorable the Mayor and the Board of Supervisors of the City and County of San Francisco:

GENTLEMEN:—In accordance with your resolution of April 26th, 1875, inviting proposals for water supply for the city of San Francisco, the Clear Lake Water Works respectfully submit the following proposition:

The Clear Lake Water Works will build, in a substantial and workmanlike manner, and fully complete water-works of capacity sufficient to deliver in the city and county of San

Francisco, for the use of the inhabitants thereof, at such reservoir as the city may designate and provide for that purpose, at an elevation not exceeding 370 feet, 50,000,000 gallons per day of good, pure, fresh water.

The Clear Lake Water Works will also construct the conduit from the source of supply to the heights north of Benicia of sufficient capacity to carry 100,000,000 gallons daily. The length of pipe from said heights will be thirty-nine miles; the size of main pipe will be sixty inches diameter; Carquinez Straits and the Bay of San Francisco to be crossed by three pipes of forty inches diameter.

The maximum thickness of pipe shall be ½ inch, the minimum thickness will be such as the minimum depression below the hydraulic grade will admit of with safety.

The length of time required for said works to be fully completed, conveyed and delivered to the city shall not exceed three years from the date of signing the contract therefor.

The City and County of San Francisco, in consideration of the building, equipping, furnishing and delivering to said city and county said water-works and said water as before mentioned, shall pay to said Clear Lake Water Works the sum of $9,650,000, as follows: 9,650 bonds of said City and County of San Francisco of the denomination of $1,000 each, payable in 30 years from the date thereof, and bearing interest at the rate of six per cent. per annum, payable semi-annually, on the first day of January and July in each year; principal and interest payable in gold coin of the United States; said bonds to be delivered as the work progresses as follows: said works shall be divided into sections as may be hereinafter agreed upon and specified in the contract, and when each section of said works shall be completed, he Clear Lake Water works shall receive 75 per cent., of such proportion of said $9,650,000 of bonds as such section shall bear to the whole number of sections in said works. The balance of 25 per cent. on each section to be paid when said works shall be finally completed, and delivered to and accepted by the city.

All work which may be done pursuant to the foregoing proposition to be subject to the approval of such engineer as the authorities of said city and county may appoint for that purpose, and no payment to be made until such engineer shall certify that such works have been constructed in accordance with contract, plans and specifications.

The title to the works, right of way, and right to use and appropriation of the water, shall be perfect and free from all encumbrance when the same is delivered and conveyed to said city and county.

If the above proposition is accepted, the Clear Lake Water Works will give satisfactory bonds for the faithful execution of the terms thereof, and of the contract to be entered into in pursuance therewith.

The Clear Lake Water Works, by
JOHN BENSLEY, President.

San Francisco, May 3, 1875.

THE MOUNT GREGORY WATER AND MINING COMPANY.

To the Honorable the Mayor and Board of Supervisors, etc.:

Gentlemen—The Board of Directors of the Mount Gregory Water and Mining Company propose to enter into a contract with your honorable body to construct a system of water works, consisting of reservoirs and aqueducts, to supply the city of San Francisco with water, and to transfer to you the same, with the right and title to the sources of supply, on the following plan and conditions:

To conduct to the city of San Francisco, in each day of twenty-four hours, 60,000,000 gallons of water from the Rubicon River (which is the south fork of the middle fork of the American River), at a pressure that will raise the same to an elevation of five hundred feet above tide water in this city.

The aqueduct to be all iron pipe, commencing at or near a point where the Rubicon River

crosses the line of Range 12 east of Monte Diablo meridian, according to the U. S. land surveys, and deliveriug the same from a continuous iron pipe at or near Hunter's Point. The pipe to be of the best boiler sheet iron, and made in a first-class and workmanlike manner, and all to be tested at one and one-half the known constant pressure contained when filled. These pipes are to be coated with asphaltum, and provided with the most approved gates, air-chambers, drains, stops, etc.

Also, to construct three reservoirs; one to be located at the head of the pipe line on the Rubicon River, another to be located in El Dorado County, at an elevation of fifteen hundred feet above tide water, and another in Alameda County, at an elevation of six hundred feet above tide water. The two last having a storage capacity of 200,000,000 gallons each, in addition to the large quantity held in the lake reservoirs. The iron pipe will take the water pure and clear directly from the river reservoir, at an elevation of over 3,000 feet above sea level, and will cross the north fork of the American River near Folsom; thence to the Sacramento river in the vicinity of Sacramento City, crossing the Sacramento River near the city; thence following near the general route of the California Pacific Railroad to South Vallejo; thence crossing the Straits of Carquinez and as direct as possible to Alameda; thence across the bay of San Francisco to Hunter's Point, a total distance of 150 miles, more or less.

The above system of conduits and reservoirs, constructed in the most approved and workmanlike manner, together with the water rights to the waters of the Rubicon River, the Mount Gregory Water and Mining Company will transfer and sell to the city of San Francisco, for the sum of ten millions of dollars, in the bonds of said city and county, payable in forty years, with interest at the rate of six per cent. per annum, said amount to be paid to said company as follows, to wit: seventy-five per cent. of the price as the work progresses, payable upon the completion of each twenty miles of pipe laid. The balance to be paid on completion of the work. The whole to be completed within two years from the date of the signing of contract. Further, the Mount Gregory Water and Mining Company will sell and transfer their water right to the city of San Francisco for the sum of five hundred thousand dollars.

The said Mount Gregory Water and Mining Company is prepared to enter into any required amount of bonds for the faithful performance of said contract, ro to make arrangements with your honorable body as shall appear for the best interest of the city.

The company has a canal in part constructed, eighteen miles of which is completed, with a capacity of conveying 3,500 inches, or 60,000,000 gallons of water per diem, for mining purposes, on Mount Gregory ridge, in El Dorado County, California. This part of the water of the Rubicon will be thus applied unless diverted as herein proposed.

The source proposed is the Rubicon River, being the south or main branch of the middle fork of the American River. This stream is made by two main branches and in other streams which spread out like a fan, one coming in from the north and the other from the south, and thus gathering the water from the snow-covered granite ridges of the high Sierra, embracing an area of from four to five hundred square miles. In this region the snowfal is excessive and is never seriously affected by the most extreme seasons of drought. When the valleys of California and the Coast Range are desolate and barren for want of moisture, the rocky peaks and deep cañons of the Rubicon are stored with the everlasting snow. The annual fall of rain and snow in the region of drainage is equal to a fall of 100 inches of water. It may be well to state that, as a general rule, more water falls in elevated than in low regions. Were it possible to store and utilize the large quantity of water from this watershed a daily supply of 2,000,000,000 gallons could be furnished during the year.

The pure water is therefore abundant for any demand that can be made upon it. The region abounds in most beautiful and romantic lakes, there being some thirty of them of various areas, lock-bound and fed by the never failing snow which here lies in the secluded cañons throughout the year. These lakelets could very easily be made reservoirs if at some future time the demands for water made it necessary. At the elevation where they lie, frosts prevail every night throughout the year, keeping the water cool and pure.

The amount of sixty million gallons per day is mentioned, as that amount would flow in the dryest season without a reservoir, and as it is six times the amount now furnished by

the Spring Valley Company, and is one-third the amount supplied London with its four millions of inhabitants, it is deemed sufficient for many years to come. The amount could be greatly increased by extending and increasing the pressure on the receiving pipe, or at some future time a parallel line of pipe could be laid.

The pipe proposed in this construction is of rolled iron, No. 3, Birmingham gauge, for the lower levels, and No. 6, the same gauge, for the upper levels. The length of the pipe will be one hundred and fifty miles, more or less.

The work to be finished within two years from the date of contract. We respectfully suggest that in the contract a line of telegraph be constructed along the line of the work. It will be of immense benefit in the construction and future operation of the work when completed.

The company's title and ownership to the waters and right of way is acquired and confirmed under and by virtue of the laws of the State of California, and by Act of Congress, passed July 26, 1866, entitled "An Act granting the right of way to ditch and canal owners over the public lands, and for other purposes," and by actual appropriation of the same since 1871, and there is no conflicting title whatever, we being the only claimants on record in El Dorado County to the said water right.

The above report and estimates are most respectfully submitted,

JOHN DAGGETT, President.
M. D. FAIRCHILD, Superintendent.
MYRON ANGEL, Secretary.
JNO. C. BURCH,
O. L. C. FAIRCHILD,
Directors.

C. S. BULKELEY,
F. TAGLIABUE,
} Engineers.

THE EL DORADO WATER AND DEEP GRAVEL MINING COMPANY.

To the Honorable Board of Supervisors
of the City and County of San Francisco:

GENTLEMEN:—While the time allowed by the resolution of your honorable body on Monday evening last, inviting proposals for the supplying of the city of San Francisco with water, is too limited to prepare the specifications with the minuteness of detail required by said resolution, yet the undersigned desire, in behalf of the El Dorado Water and Deep Gravel Mining Company, to submit for your consideration the following general statement concerning their water rights, and to invite such an examination of the advantages possessed by this company for supplying the city and county of San Francisco with pure water, as you may deem expedient to institute. This company was incorporated by a number of leading citizens of San Francisco, September 4, 1873, for the purpose, among other things, of supplying "pure, fresh water to the public, and to any city, city and county and town in the State of California." Its water rights consist of all the water of the South fork of the American River and its numerous tributaries, together with a number of lakes on the summit of the Sierras, ranging from 7,000 to 8,000 feet elevation, all fed by the heavy rains and deep snows of a watershed of 500 square miles in extent.

The four principal lakes alone aggregate an area of over 10 square miles, and have at present a storage capacity equal to a supply of 115,000,000 gallons daily for 365 days, and which can be greatly increased at a merely nominal expense. In addition to these lakes the watershed embraces numerous advantageous sites for artificial reservoirs, which can be made to more than double the storage capacity of the lakes themselves, thus making the water supply practically unlimited.

Mr. F. A. Bishop, the engineer of this company, who has been familiar with these water rights for the past twenty years, from long personal observation, and the known rain and snow fall of this region, estimates that the water passing at the point where we tap the South Fork, some 4,000 feet above tide water, is equal to 60,000 miner's inches daily, and which is equivalent, in round numbers, to 1,000,000,000 gallons, of which, if we take only 50 per cent., we shall have a daily supply of 100 gallons per capita for 5,000,000 inhabitants.

This company and its predecessors have expended within the past twenty years over $1,200,000 in maintaining and utilizing these waters, and have been engaged for the past twelve months in the construction of a canal and the necessary reservoirs to deliver in the neighborhood of Placerville, within the present year, 100,000,000 gallons daily.

For comparatively a small additional outlay this water can be brought and reservoired in the neighborhood of Latrobe, which affords ample elevation to deliver the water at any desirable point within the county. From the Latrobe reservoir it is proposed to pipe the water to San Francisco, a distance of about 130 miles, where it would again be stored. But for obvious reasons, of both economy and convenience, it has been suggested by our engineer that this should be only done as required by actual consumption, that therefore much smaller pipes can be employed than those upon which the estimates have been usually based in connection with this question. From the preliminary estimates of Mr. Bishop, we are entirely confident that 100,000,000 gallons of water can be delivered at San Francisco at a cost not exceeding $10,000,000.

The advantages, then, of this scheme over all others yet proposed, consist:

First.—Of its ample capacity for supplying all future wants, and the extent of the natural storage afforded.

Second.—That while it affords an ample supply for San Francisco for all time to come, with but small additional expense, the cities of Sacramento, Stockton, San Jose, Oakland and Alameda can be supplied simultaneously; and therefore it is highly probable, if not absolutely certain, that these cities would sooner or later join San Francisco in the expense of increasing the supply as it might be needed from time to time by increase of population.

Third.—The much smaller cost to the city than any other scheme yet proposed, which at all approaches it in magnitude or other natural advantages.

Fourth.—That the unequalled purity of the water, which, by a careful and thorough analysis made from a sample taken at our dam on the south fork, is shown to contain only 1¾ grains of solid matter to the gallon, composed of 1¼ grains of carbonate of lime, the balance consisting of the salts of soda and potassa, and as the intervening country over which it has to be conducted is of a granite and slate formation, its purity cannot be impaired by foreign substances.

While, therefore, as before stated, the time allowed is too limited to enable us to make a definite proposition, as contemplated by your resolution, if your Honorable Body will institute such an examination of our property as may be necessary to verify these general statements, we shall be happy to submit a more definite proposition than we are now able to make.

Respectfully submitted,

LOUIS A. GARNETT,
President El Dorado W. & D. G. M. Company,

J. D. FRY, Vice-President,
THOMAS PRICE,
JOHN O. EARL,
H. D. BACON.

THE AMADOR CANAL AND MINING COMPANY.

To the Honorable the Mayor and Board of Supervisors
Of the City and County of San Francisco:

GENTLEMEN—In accordance with your resolution inviting all parties owning or interested in water rights to present to your Board estimates and proposals to furnish the city with water, etc., etc., the undersigned beg to submit for your consideration the following facts in relation to the water rights and works belonging to the Amador Canal and Mining Company.

The works of this company are located in Amador County. It lays claim to all the waters of the north fork of the Mokelumne River, and has, at an outlay of nearly $600,000, diverted the waters of said stream. The main canal is 45 miles long, and runs from its head to its distributing reservoir in the direction of San Francisco. The distributing reservoir covers three acres of ground, and is situated above and in the immediate vicinity of Sutter Creek, in Amador County. It is 1,370 feet above tide-water, and less than 100 miles, in a direct line, from San Francisco. Five miles above the distributing reservoir the company are now constructing, and will have completed by the 1st of July next, a reservoir of a capacity of 800,000,000 gallons of water. The present carrying capacity of the canal is 5,943 cubic feet per minute, or 64,016,640 gallons in 24 hours. At the head, the canal receives the water of the river in such a manner as to avoid the necessity of a dam, always liable to be swept away or damaged by floods.

That your honorable body may the better judge of the magnitude of this work, the character of the water and its abundance, extracts from the reports of the different engineers who have examined and reported on this work, and a pamphlet containing the reports of A. C. Austin, C. E.; of General B. S. Alexander, U. S. Engineer; of C. A. Pudington, canal builder and engineer; of W. L. McKim, Engineer of Sutter Canal and Deputy United States Surveyor, and of General Sherman Day, late United States Surveyor-General, are herewith submitted. The last report was made in 1874, and all the former ones in 1871.

General B. S. Alexander, in reporting on this work, says: "The elevation at this point of the river (which is the head of your canal) is 1,894 feet above tide-water. The elevation of your distributing reservoir above tide-water is 1,370 feet. Your canal is eight feet wide on the top, five feet wide on the bottom, and three feet deep, with a grade of eight feet to the mile. The capacity of your canal, when full of water, will be 64,016,640 gallons in twenty-four hours. In conclusion, I will observe that I have no doubt of the sufficiency of the supply of water in the Mokelumne River, at all seasons, even in the driest year, to furnish your new canal with all the water it can convey, even were it enlarged to twice its present capacity. It is a fine mountain stream of clear water, running over a granite bed. When the demand for water increases so as to justify the enlargement of your canal, its carrying capacity may be increased 50 per cent. at a very small cost. This can be done by merely making it six inches deeper. The capacity of your canal would then be fully 100,000,000 gallons per day, enough to supply all the mines of the Mother Lode of Amador County with all the water they can use, and irrigate 30,000 or 40,000 acres of land to an average depth of two feet in the year, or to supply a large city with water."

A. C. Austin says: "In regard to the general character of the work, it is one of very great magnitude, and will compare most favorably with any work of the kind I have ever examined."

C. A. Pudington reports: "I think there need not be any fear as to having a good supply. And in conclusion, I must draw your attention to the fact that this season is unusual, and cannot be taken as a sample by any means; for streams that afforded water heretofore at this time are dry. I think the day is not far distant when it will be found that the water from this canal will be taken to Stockton, if not to San Francisco."

Sherman Day says: "The canal takes its water from the north or main fork of the Mokelumne River, about three or four miles above West Point. The river flows over a bed of solid granite and heavy granite boulders, with precipitous rapids. I made two visits to

the head of the canal during the last week in August, to determine whether sufficient water was flowing to fill the canal. The main body of snow in the mountains had been melted some weeks since, and the water in this river and in all the neighboring region was said to be lower than it had been for several years." After making accurate measurements of the water in the river, he says: "I judge, therefore, that in this dry season of a very dry year, the river is flowing enough to fill the canal."

The Amador Canal and Mining Company claims to possess the finest water privilege and works in the State. No purer or sweeter water can be found in the world. The supply is inexhaustible. The watershed, reaching from the summit of the Sierras to the point on the river tapped by the canal extending for miles on either side, covers a greater area than the watersheds of the Lake Tahoe, Blue Lakes, Calaveras and Spring Valley water schemes combined.

It is a noticeable fact that the mountain ranges in Amador county extend further into the valley than the ranges of the other counties north and south of it. This explains the shortness of this route—151 miles—and makes Amador county the natural source of water supply for San Francisco. Your engineer, in recounting the advantages of the Calaveras scheme, makes the novel assertion that in case of civil war the supply from a mountain source would be endangered. Mr. Scowden forgets that a foreign war, the most likely to occur, will most endanger those works situated nearest the ocean.

Estimated cost of enlarging the canal to carry 125,000,000 gallons of water each day, $6,000 per mile, $270,000. From Sutter the canal can be continued toward Ione, a distance of six miles. Estimated cost, $20,000 per mile, $120,000. From vicinity of Ione to San Francisco, 100 miles, by means of wrought iron boiler plate pipes, averaging one-quarter of an inch in thickness and 60 inches in diameter, capable of carrying 50,000,000 gallons of water every 24 hours, delivered into a reservoir at the necessary height, $6,600,000. To construct the necessary reservoirs above the head of the canal, with storage capacity of 18,500,000 gallons of water, including reservoirs near San Francisco, $300,000. Contingent and other expenses, $1,458,000. Present works, including canal, reservoirs, franchises and water rights, $1,500,000.

RECAPITULATION.—Enlarging old canal, $270,000; constructing new canal, $120,000; pipe from vicinity of Ione to San Francisco, $6,600,000; reservoirs, $300,000; contingent and other expenses, $1,458,000; total, $8,748,000; present works, franchise and water rights, $1,500,000. Grand total, $10,248,000.

The Amador Canal and Mining Company will, for the use of all surplus water, keep all the works constructed by said Company for the city, in repair at its own expense.

It will agree to have the full supply in the city within two years and six months after the signing of the contract.

J. S. EMERY, President.
F. M. BROWN, Gen'l Manager.

SAN FRANCISCO, May 3, 1875.

BLUE LAKE PROPOSITION.

To the Board of Supervisors of San Francisco County:

I hereby propose to your honorable body to ratify and confirm the proposal heretofore made on my behalf by my counsel, H. O. Beatty. But as that proposition was not as full as is necessary to explain the details of my scheme, I make the following specifications:

The lakes are on the summit of the Sierra Nevada mountains, in the counties of Alpine and Calaveras, State of California.

The supply will always come from an altitude above sea level of 7,000 to 10,000 feet.

For eight months of the year the natural flow of the river from four hundred square miles of melting snow gives the supply.

Four months of the driest season a portion of the supply will be taken from lakes and springs that percolate from granite peaks and perpetual snows 8,000 and 10,000 feet high.

I refer to the report of Col. Scowden as to the quantity, quality, etc., of water.

The canal, when not excavated out of rock, shall be stone-lined.

Water, in time of rain, running from roads, trails, lands improved, and ravines, and all water carrying impurities, will be conducted over the canal. No wood will be used in any portion of the whole system.

Iron pipes will be used to cross sags, gulches, and streams.

The canal shall have a grade of 6.40 feet per mile.

The canal is to be 12 feet top, 8 feet bottom, 6 feet deep.

Capacity in cross section, 60 cubic feet.

Delivery, 228,096,000 gallons in 24 hours at the end of the canal, with a flow of four miles per hour.

Evaporation, absorption, and leakage allowed, will deliver at the entrance of pipe 200,000,000 gallons per day.

All tunnels will be lined with masonry when not excavated in solid rock.

Stone arches for road warp and farm crossings.

Inverts will rest on masonry and be protected by side walls.

All trees will be felled that will reach the canal by falling.

All trees standing within the margin of the overflow of the lakes will be removed, root and branch.

The increased storage of water in the lakes will be by embankment, constructed of earth and stone, over which the water will never be allowed to flow.

The waste weirs not already formed by natural outlet, will be cut through solid rock or be protected by walls of stone.

The outlet for supply will be by gate placed at a proper point in a tunnel constructed through solid rock, having no connection with the embankment or protection walls.

I will furnish storage capacity to the extent of ten billions gallons in the upper lakes, the lowest to be over 7,500 feet above the sea-level. The pressure of water against the artificial dams in no case to exceed fifty feet. This ten billions of gallons can be readily doubled when the future growth of the city shall make a greater supply necessary.

Altitude at dam, 3,000 feet. Altitude at the end of canal or commencement of pipe, 1,450 feet. Altitude connection with the main pipe from Butte Valley reservoir, 1,350 feet.

The water will flow directly from the river and mountain streams through the canal and into the pipe to San Francisco without entering any reservoir, and arrive for distribution as fresh and pure and almost as cold as when rippling down from the summit snows.

A reservoir will be constructed at the summit of Livermore Pass, near Altamont, from which the supply may be drawn at an elevation of 700 feet above sea level. Another reservoir will be constructed in Livermore Valley, one mile northeast of the town, at an elevation of 550 feet above sea level, with a superficial area of 2,460 acres, having a capacity of over fifteen and a half billions of gallons, or a supply of 50,000,000 of gallons a day for over 300 days. These two reservoirs will be filled and drawn from by side gates.

A stream will constantly flow from the main pipe into these reservoirs sufficient to keep the water fresh and pure.

No supply will be needed or used from any of the reservoirs except in case of accident.

I refer to the Engineer's report as to the distance by natural flow, canal and pipe to the San Francisco reservoir.

I propose to lay the pipe around the bay by way of Alviso, adding the increased distance to the length of pipe, and thereby avoid the objections to crossing the bay.

Gates and man-holes will be placed at proper points from end to end.

The pipe shall be coated inside and out with asphaltum.

The plate will be double line riveted horizontally, and single line vertically.

The pipe will be trenched and covered, and protected by parallel ditch.

The crossing of the San Joaquin river will be passed by tunnel, under the river, lined with hard brick, laid in cement, ten feet in diameter.

The thickness of iron necessary to sustain the pressure and carry its strength for a long period of time is classed as follows:

From the inlet to 600 feet below the Livermore Summit, one-quarter of one inch thick; below six to seven hundred feet, five-sixteenths; at seven hundred to seven hundred and fifty, three-eighths of one inch thick. That portion under the San Joaquin River one-half an inch thick boiler plate, and all to be of the best quality of iron.

The size of pipe at inlet will be seven feet in diameter, gradually diminishing down to forty-eight inches in diameter, when it will carry the same diameter to the summit at Livermore Pass. From the summit at Livermore Pass down to six hundred feet pressure above sea level, the size will be gradually diminished to forty-four inches in diameter, and continue at that size to the end, or to the entrance of reservoir at San Francisco, with a delivery of fifty millions of gallons per day.

The whole estimated cost of the iron piping is ten millions of dollars, or at the rate of two hundred thousand dollars per each million of gallons per diem. As your engineer estimates that it will require a larger pipe to deliver fifty millions of gallons per day than I estimate for the same purpose, I will agree, that if the pipe I propose to use falls short of fifty millions of gallons a day, I will deduct from the price two hundred thousand dollars for each million of gallons of deficiency. If, on the other hand, it exceeds that quantity, the city shall either pay me two hundred thousand dollars for each million gallons of the excess, or regulate the flow so as only to get fifty millions of gallons a day, and allow me to dispose of the surplus at Livermore Valley, or at any other place, until the city needs this extra water, when the same is to be paid for at the rate of two hundred thousand dollars per million gallons of daily supply.

It will be perceived that my detailed offer adds about one hundred millions per day to the carrying capacity of the canal, about twenty billions to the storage capacity of the reservoirs, and about ten miles additional iron pipe beyond the original offer made for me by H. O. Beatty, with only one million dollars increase in cost.

W. V. CLARK.

At a meeting of the Board held on the 17th day of May, 1875, Supervisor Deering presented the following supplemental report of the engineer, containing estimates of cost and description of real estate, water-rights, etc., connected with the Calaveras Valley water supply; also estimates of cost of conveying said water to the city, operating and maintaining the works as contemplated; also presented maps of the Calaveras Division of the city water supply, showing the reservoir and watershed, and map showing the lands claimed by the Alameda Water Company, situated in the counties of Alameda and Santa Clara.

FIRST SUPPLEMENTAL REPORT.

To the Honorable the Mayor and Board of Supervisors of the City and County of San Francisco:

GENTLEMEN: I beg leave to submit herewith the maps, plats and description of property and plan of works known as the Calaveras Water Supply, recommended by me to furnish San Francisco with an ample supply of pure and

wholesome water, and designed to furnish one hundred gallons of water per diem to each inhabitant of a population of half a million. Owing to a pressure of office and field work at the time the engineer's report was submitted, the maps, plats, estimates of cost of real estate, and all water-rights, titles and interests, which the law required to accompany the report, could not be had in readiness, but have since been prepared, as also the estimates of cost of maintaining the proposed works in operation and repair, which works and interests the parties owning and controling the same would be required to convey to the city in the event of sale thereof.

Referring to the above mentioned maps and plats, it will be seen that the real estate described comprises 4,879 45-100 acres of land, which embrace the site for the main storage reservoir and all parts and parcels of land appertaining to the Calaveras Water Supply, described as follows :

DESCRIPTION OF PROPERTY.

Southwest ¼ of Section 13; southeast ¼ and east ½ of southwest ¼ of Section 14; east ½ and east ½ of northwest ¼ of Section 23; west ½ and southeast ¼ of Section 24 ; all of Section 25; east ½ of Section 26 ; northeast ¼ of Section 35; all of Section 36—situated in Township 5 south, range 1 east of the Mount Diablo meridian, and containing an aggregate area of 3,040 acres. Also, southwest ¼ and south ½ of southeast ¼ of Section 19 ; south ½ and south ½ of northwest ¼ of Section 29; all of Section 30; west ½ of Section 31, situated in Township 5 south, Range 2 east of the Mount Diablo meridian, and containing an aggregate area of 1,600 acres. Also, all of Calaveras Creek in the southeast ¼ Section 11, containing 5.34 acres ; all of Calaveras Creek in the northwest ¼ of Section 11, containing 7.80 acres ; all of Calaveras Creek in the east ½ of Section 3, containing 15.71 acres; situated in Township 5 south, Range 1 east of the Mount Diablo meridian. Also, all of Calaveras Creek in the Rancho Valle de San Jose, north of C. Hadsell's south line, and situated in Sections 16, 17, 20 and 21, in Township 4 south, Range 1 east of the Mount Diablo meridian, and containing 131.81 acres. Also, all of Alameda Creek in northwest ¼ of Section 17 ; northeast ¼ of Section 18 ; southeast ¼ of Section 7 ; containing 15.02 acres ; all of Alameda Creek in the southwest ¼ of Section 7, containing 12.25 acres ; all of Alameda Creek in Section 11, containing 31.82 acres ; also all of Alameda Creek in Sections 10 and 15 up to the line of the Washington and Murray Townships Water Company, containing 19.70 acres, situated in Township 4 south, Range 1 west of the Mount Diablo meridian.

The value of said real estate, together with all rights, title, privileges, and interest appertaining to, and connected with the Calaveras water project, to make the same complete when conveyed to the city, is estimated at	$1,150,000 00
Cost of construction, as per engineer's report	10,655,052 00
Total cost of works, complete	$11,805,052 00

COST OF MAINTENANCE.

The cost of maintaining the contemplated works in successful operation and repair, is estimated as follows:

Salary of President of works, per annum	$5,000 00
Salary of Engineer of works, per annum	6,000 00
Salary of Secretary of works, per annum	3,500 00
Office force, consisting of bookkeeper, clerks, inspectors, assistants, night watch, and porter, stationery, rent, etc., etc., per annum	3,500 00
Street force, reservoir, and conduit managers, pipe-laying superintendence, and general repairs, per annum	45,000 00
	$94,500 00
For contingencies, add 10 per cent.	9,450 00
Total cost of maintenance, annually	$103,950 00

My attention has been called, by your Committee on Water Supply, to the several proposals lately submitted, to supply the city and county with water, by the Mount Gregory, Amador Canal, El Dorado, Lake Tahoe, Clear Lake and Blue Lake companies, and I am requested to investigate and report upon the same. In reply, I desire to say that in looking over these proposals I discover that they are not in conformity with the law, which requires that the engineer appointed by your honorable body shall make accurate examinations and surveys of all the plans proposed and which the city may contemplate to purchase, and to prepare and file with his report, correct maps of the same, which have not, nor at this late date can be made and prepared in time to vote upon at the coming election. The legal difficulties here interposed by the act of the Legislature render the entertaining of these proposals by your Board, or any negotiation for their purchase, impracticable. It may also be stated with regard to these proposals, that they are not accompanied by the necessary plans and specifications from which correct estimates of their respective values can be determined, also required by law.

It is evident that the basis of computation adopted was from a much lower standard than that used in making the estimates of cost of the Calaveras and other works reported upon by your engineer. As illustrative of the effect of computing by different standards, your Board is cited to that adopted for Lake Tahoe, as compared with that for the Calaveras scheme, which will apply to, and suffice for, all the proposals made.

Original estimate of cost of Calaveras scheme	$10,655,052 00
Present estimate—real estate, water right, etc	1,150,000 00
	$11,805,052 00

Difference of cost affected by reducing the Calaveras standard to that of Lake Tahoe, would be as follows:

1st. Deduct omission of Rock Creek reservoir and pipe distribution in city	$2,617,239 00
2d. Deduct 881,000 cubic yards, Calaveras dam, quantity reduced, at 40 cents.	352,400 00
3d. Deduct paving and fencing, quantity reduced..	15,282 00
4th. Deduct 18,371 tons wrought 60-inch pipe, weight reduced by change from thick, strong pipes to thin, weak ones at $120..	2,204,520 00
	$5,189,441 00
For contingencies add 10 per cent	518,944 10
Total deduction..	$5,708,385 10
From estimate of cost of Calaveras scheme	$11,805,052 00
Deduct the above difference	5,708,385 10
Cost of Calaveras reduced to Lake Tahoe standard	$6,096,666 90

Here it is shown that by reducing the standard adopted for estimating the cost of the Calaveras scheme to that by which the cost of the Lake Tahoe scheme was estimated, the former would be reduced from $11,805,052.00 to $6,096,666.90, while the price of the property and water rights owned by the vendors of the Calaveras project would be unaffected by the change. Works built upon a plan deficient in requisite strength of parts, and subject to continued accident and necessary repairs such a change would involve, besides lacking head of water (the reservoir head being reduced from 450 feet to 370 feet, a difference of 80 feet), would, in the opinion of your engineer, render the Calaveras project for serving the high levels of the city entirely inefficient. Works should be built that would insure utility and reliability as well as durability, and of such a character as to place them beyond the probable contingency of accident, and thus provide an unfailing supply of water. Such works are the cheapest in the end and the best that can be built. As between efficient and permanent works and those that are temporary and unreliable, the former would receive the unqualified approval, and the latter the unqualified condemnation, of your engineer.

After carefully comparing the several proposals made and plans reported upon with the Calaveras scheme, and taking time to reconsider the water question in all its aspects and bearings, your engineer still adheres to the plan of works recommended by him, without any reason that he can conceive to alter it in any respect.

Respectfully submitted,

T. R. SCOWDEN,
Chief Engineer City Water Supply.

San Francisco, May 17th, 1875.

The Special Committee on Water Supply, by Supervisor Deering, presented the following Report, on May 17th, 1875, recommending the Calaveras Valley as the most available locality for securing the necessary water supply:

REPORT OF SPECIAL COMMITTEE ON WATER SUPPLY.

To His Honor the Mayor and the Board of Supervisors:

GENTLEMEN—Your Committee on Water Supply for the City and County of San Francisco, beg leave to submit the following report:

In order to obtain all useful and necessary knowledge of the respective advantages and disadvantages connected with the different sources of water supply, we visited the valley of Calaveras, and examined in sequence thereafter, Clear Lake, the Blue Lakes, Pescadero Creek, the Spring Valley Water Works and the Laguna de la Merced.

We thus became familiar with the localities containing the sources of water supply, the character of the water, the relative distances from the city, and the nature of the intervening obstacles and engineering difficulties to be overcome. On some of the longest lines of canal and conduit for bringing water to the city, the question of cost and contingencies of accident and interruption of the supply, as compared with the shorter lines of canal and conduit, the diminution of cost and fewer contingencies, and consequently more permanent and reliable supply, are the grave ones to be taken into consideration by this Board.

The advantages of securing a good quality and ample quantity of water for all needful purposes, throughout the year, and from year to year, will assert supremacy in your minds, as they have in the minds of your committee.

To provide works that will furnish a bountiful supply of water to householders and the general consumers of water, at the least possible cost, and in a great measure remove other vexatious taxes in the form of insurance on perishable property, and those arising from the causes of sickness and mortality, as shown by the Engineer's report, would be conferring the greatest benefit our Board could bestow on this community. We believe that you will have little hesitancy in proposing to the people of San Francisco the locality which has been found at a comparatively short distance from the city for their favorable consideration. We respectfully refer this Board to the detailed statement made in the report of the Chief Engineer of Water Supply for full information upon this subject and other important matters connected with water supply.

The scheme proposed, and which is so clearly and strongly recommended for your careful consideration, with respect to the valley of the Calaveras, as the most desirable source of supply, all things considered, is supported by facts and reasons to our minds convincing and irresistible, confirming, as they do, our own information and conclusions. We cannot refrain as an act of duty from strongly urging the acceptance and adoption of the recommendation of our Engineer in his report to the Board, designating the Calaveras Valley as the most available locality for securing the necessary supply of water for the city and county.

Your committee find that under the resolutions of the "water enactment" they are powerless to enter into any negotiations as to proposals to supply the city with water from points that have not been visited by them, and reported on by our Engineer.

If we had any grave reason for differing with Mr. Scowden's conclusions, we should avail ourselves of this opportunity to offer them; but his greater knowledge and experience in so important a matter as furnishing our citizens with an abundant supply of pure, fresh water, which he has imparted to us, removes any doubts in our minds as to the course we should pursue.

In this matter we have moved cautiously and considerately, and after careful examination of the various plans presented and reported upon, we feel confident that we have recommended the most feasible proposition of the many presented to us for consideration.

Experience has demonstrated the futility of all temporary works for supplying water to a city. We therefore conclude that the interest of the city is best subserved by erecting or purchasing works of a permanent and enduring character, such as are recommended by the Engineer. Every citizen of San Francisco, whether capitalist, business man, mechanic, or laborer, who is taxed for water, is deeply interested in and impressed with the necessity of a cheap and abundant supply of good, wholesome water, as one of the great necessaries of life.

The present size and population of our city, as compared with what it probably will be twenty-five years hence, when the heights and non-occupied portions will be covered by the habitations of a crowded city, render it necessary to now provide liberally and amply for its great and growing wants.

To accomplish the ends in view, bonds would have to be issued in conformity with the Act, payable in thirty years, the interest accruing being at the rate of six per cent. per annum, and the sinking fund not being levied or created until ten years after the issuance of said bonds, would create an indebtedness that would not be burdensome to the citizens and consumers of water, as the revenue of the works, when built, would, in the opinion of your committee, pay the interest on the bonds from the start, and in a short period be sufficient, even at a very low price for water, to create a sinking fund to pay the principal when due.

Our people would no longer complain of short allowance and high price for water, but could enjoy all the luxury, comfort and benefits derived from water supplies, in quality unexceptionable and in quantity without stint, at the lowest cost of obtaining it.

Respectfully submitted,

JAMES H. DEERING,
M. LYNCH,
A. W. SCOTT,
D. A. MACDONALD,
A. M. EBBETS,
Committee on Water Supply.

San Francisco, May 17, 1875.

The Special Committee further presented the following resolution, declaring it to be expedient and proper to purchase the water, water-rights, and property, etc., of the Alameda Water Company, which was passed for printing:

Resolved, That it is the opinion of this Board, after a careful and thorough examination and consideration of the report of T. R. Scowden, engineer on the various sources of water supply, that it is expedient and proper and for the interest of the city and county of San Francisco and her inhabitants to acquire, by purchase, for said city and county, the water-works, reservoirs, pipes, flumes, ditches, distributing mains, water rights and real estate owned by the corporation known as the Alameda Water Company, and the real estate connected therewith, with all the water rights, creeks, ponds, springs and sources of supply pertaining thereto, as shown by the reports and surveys filed of T. R. Scowden, Engineer of Water Supply, and owned by said Alameda Water Company. Also, to contract with said corporation to furnish, construct and put in operation the necessary reservoirs, distributing mains, pipes, flumes, tunnels, ditches and machinery to furnish an abundant supply of pure, fresh water, as contemplated and provided in an Act of the last Legislature, approved March 30, 1874.

Resolved, That the Committee consisting of the Mayor, Auditor, and City and County Attorney be, and is hereby authorized and empowered to view and carefully examine the property hereinbefore mentioned, and to enter into negotiations with the corporation known as the Alameda Water Company, and to contract with and purchase from said corporation their water-works, reservoirs, distributing mains, pipes, flumes, ditches and water rights owned and claimed by said corporation, and the real estate connected therewith, and to contract with said corporation to furnish, construct and put in operation the necessary reservoirs, distributing mains, pipes, flumes, tunnels, ditches, and machinery to furnish this city and county and her inhabitants with an abundant supply of pure, fresh water, and report the result to this Board as soon as practicable.

Supervisors Pease, Kenney, Ebbets, Sims, Deering, Roberts, Scott, Lynch and Macdonald voting for, and Superviors Menzies, Block and Hewston against, the passage to print of the resolution. On the 24th day of May, the following communication from trustees, etc., of the San Francisco and Alameda Water Company, claiming to own the waters of the Alameda Creek and Calaveras Valley, was received and referred to the Special Committee on Water Supply, to-wit:

To the Board of Supervisors of the City and County of San Francisco:

The undersigned, trustees and stockholders of the San Francisco and Alameda Water Company, duly incorporated under the laws of the State of California (the certificate of incorporation having been filed in the office of the County Clerk of the City and County of San Francisco, June 3d, 1865, and also in the office of the Secretary of State, June 5th, 1865, and there recorded in book N, page 281), hereby give notice that said company claim the waters of the Alameda creek, in the county of Alameda, California, and of all its tributaries, including the waters of the Calaveras Valley running into said Alameda creek, as a part of its corporate property and franchise, and that it is so named and declared in its articles of incorporation; that after its incorporation, said company commenced work to carry out the purposes of its incorporation, when another company, called the Alameda Water Company, claimed the same waters and property, or a part thereof, and thereupon a suit was instituted in the courts of this State to determine the rights of the respective parties, which suit was finally adjudicated in the Supreme Court of this State, and the right

of said San Francisco and Alameda Water Company in and to said waters, was fully recognized, determined and established. See 36 California Reports, pages 639, etc.

JNO. S. HAGER,
L. MAYNARD,
LOUIS McLANE,
LLOYD TEVIS,
CHAS. E. McLANE.

SAN FRANCISCO, May 24, 1875,

On the 31st day of May, the following communication was presented, read and placed on file, to-wit :

SAN FRANCISCO, May 25th, 1875.

JAMES H. DEERING, ESQ.,

Chairman of Committee on Water Supply :

DEAR SIR—I would respectfully state, for the information of your committee, and through them to the Honorable Board of Supervisors of the city and county of San Francisco, that the Alameda Water Company have disposed of their water rights and real property appertaining thereto to the Spring Valley Water Company of San Francisco.

Yours respectfully,
C. N. FELTON,
President Alameda Water Company.

At the same meeting, the resolution introduced on the 17th inst., providing for the purchase of the water-rights and property of the Alameda Water Company, was taken up and indefinitely postponed. The Special Committee on Water Supply then presented a map of the Spring Valley Water Works, showing the reservoirs, watershed, etc., and a map showing the profile of the Spring Valley Water Company's aqueduct, which were received and placed on file. Further presented the following resolution declaring it to be expedient and proper to purchase the water, water-rights and property of the Spring Valley Water Works, including the water, water-rights, and property recently owned by the Alameda Water Company, which was passed for printing:

Resolved, That it is the opinion of this Board, after a careful and thorough examination and consideration of the report of T. R. Scowden, engineer of the various sources of water supply, and of other matters in connection therewith, that it is expedient and proper, and for the interest of the city and county of San Francisco and her inhabitants to acquire, by purchase, for said city and county, the water-works, reservoirs, pipes, flumes, tunnels, ditches, distributing mains, water rights, machinery and real estate owned by the corporation known as the Spring Valley Water Works, including the water-works, reservoirs, pipes, flumes, ditches, with water rights and real estate recently owned by the Alameda Water Company, and the real estate connected therewith, with all the water rights, creeks, ponds, springs and sources of supply pertaining thereto, as shown by the reports and surveys filed by T. R. Scowden, Engineer of Water Supply, and owned by said Spring Valley Water Works, in order to furnish this city and county with an abundant supply of pure, fresh water, as empowered, contemplated and provided in an Act of the last Legislature, approved March 30, 1874.

Resolved, That the committee, consisting of the Mayor, Auditor, and City and County Attorney be, and is hereby, authorized and empowered to view and carefully examine the property hereinbefore mentioned, and to enter into negotiations with the corporation known as the Spring Valley Water Works, and to contract with and purchase from said corporation

their water-works, reservoirs, distributing mains, pipes, flumes, tunnels, ditches, property and water rights owned and claimed by said corporation, as hereinbefore mentioned, and the real estate connected therewith, to furnish an abundant supply of pure, fresh water, and report the result to this Board as soon as practicable.

Supervisors Pease, Kenney, Ebbets, Sims, Deering, Roberts, Scott, Lynch and Macdonald, voting for, and Supervisors Menzies, Block and Hewston against the passage to print of the resolution.

On June 7th, the foregoing resolution came up on final passage. The watershed and sources of the Calaveras Valley, with the site of the reservoir for the storage of water, the property of the Alameda Water Company, being principally in Santa Clara County, opinions of the City and County Attorney were obtained and presented to the Board by Supervisor Block, reciting that by reason of a provision of an Act of the Legislature, approved March 30, 1874, there could be no appropriation or condemnation of any water or water rights in the counties of Santa Clara, Tulare, or Kern, by or on behalf of the city and county; also, that the Board of Supervisors had not the right to purchase or authorize the purchase of any land in Santa Clara County, for the purpose of securing or holding for the city and county any water or water rights in the County of Santa Clara, and had not the right to purchase or authorize the purchase of any sources of water supply in said county; also, that the water of all streams in Santa Clara County may at any time be condemned for public use in that county.

The resolution was then amended by striking out the words "including the water works, reservoirs, pipes, flumes, ditches, with water rights and real estate owned by the Alameda Water Company," Supervisors Menzies, Pease, Ebbets, Deering, Block, Scott, Hewston, and Macdonald voting for, and Supervisors Kenney, Sims, Roberts, and Lynch against, the amendment, and as amended the resolution passed for printing, Supervisors Menzies, Pease, Kenney, Ebbets, Sims, Deering, Block, Scott, Lynch, and Macdonald voting for, and Supervisors Roberts and Hewston against its passage to print.

On June 14th, the Special Committee, by Supervisor Deering, reported having filed the map showing the survey of the Laguna de la Merced property; also, that all maps showing surveys of other water sources and property, made by the engineer, not heretofore presented, would be filed prior to the next meeting of the Board, and presented an opinion of the City and County Attorney, that it was the duty of the committee consisting of the Mayor, Auditor, and City and County Attorney, to proceed to view, examine, and report to the Board, upon and with reference to the Spring Valley Water Works, mentioned in the resolution before the Board, in the event of its passage; also, and upon and with reference to the waters of the Laguna de la Merced, and the real estate connected therewith, or any other source of supply that had been visited by the Board, and reported upon by the engineer, provided a reference be made thereto in said resolution by an amendment thereof, or a new resolution be passed with reference to such water sources and property, in accordance with form of resolution prepared and heretofore submitted; also, that said

committee had no power to proceed at all with respect to any property not mentioned in a resolution of the Board, and upon the coming in of the report of the committee, it was to be passed upon and approved or dropped by the Board.

The resolution was then taken up and finally passed, as follows:

RESOLUTION NO. 7,448 (New Series).—Declaring it to be expedient and proper to purchase the water, water rights and property of the Spring Valley Water Works.

Resolved, That it is the opinion of this Board, after a careful and thorough examination and consideration of the report of T. R. Scowden, engineer on the various sources of water supply, and of other matters in connection therewith, that it is expedient and proper, and for the interest of the city and county of San Francisco and her inhabitants, to acquire, by purchase, for said city and county, the water-works, reservoirs, pipes, flumes, tunnels, ditches, distributing mains, water rights, machinery and real estate owned by the corporation known as the Spring Valley Water Works, and the real estate connected therewith, with all the water rights, creeks, ponds, springs, and sources of supply pertaining thereto, as shown by the reports and surveys filed of T. R. Scowden, Engineer of Water Supply, and owned by said Spring Valley Water Works, in order to furnish this city and county with an abundant supply of pure, fresh water, as empowered, contemplated and provided in an Act of the last Legislature, approved March 30, 1874.

Resolved, That the committee, consisting of the Mayor, Auditor, and City and County Attorney be, and is hereby authorized and empowered, to view and carefully examine the property hereinbefore mentioned, and to enter into negotiations with the corporation known as the Spring Valley Water Works, and to contract with and purchase from said owners their water-works, reservoirs, distributing mains, pipes, flumes, tunnels, ditches, property and water rights hereinbefore mentioned, and the real estate connected therewith, to furnish an abundant supply of pure, fresh water, and report the result to this Board as soon as practicable.

Supervisors Menzies, Pease, Kenney, Ebbets, Sims, Deering, Block, Scott, Lynch, and Macdonald voting for, and Supervisors Roberts and Hewston against its passage; said resolution receiving the approval of the Mayor on the 24th inst.

At the same meeting, on June 14th, a resolution was introduced by and on motion of Supervisor Lynch passed for printing, declaring it to be expedient and proper to purchase the water, water-rights, and property known as the Laguna de la Merced, and the real estate connected therewith, Supervisors Menzies, Pease, Kenney, Deering, Block, Lynch and Macdonald voting for, and Supervisors Ebbets, Sims, Roberts, Scott and Hewston against its passage, which resolution came up on final passage on June 21st, and was lost; Supervisors Menzies, Pease, Block, Hewston and Lynch voting for, and Supervisors Kenney, Ebbets, Sims, Deering, Roberts, Scott and Macdonald against its final passage.

At a meeting of the Board held on June 28th, 1875, a resolution was introduced and passed to print declaring it to be expedient and proper to purchase the water, water-rights and property connected with the Clear Lake, Blue Lakes, Laguna de la Mereed, and the Pescadero Creek, any or either of them, and empowering the Mayor, Auditor and City and County Attorney to view and carefully examine the property, and enter into negotiations with the owners, and report the result to the Board. Supervisors Menzies, Sims, Deering, Block, Hewston, Lynch and MacDonald voting for, and

Supervisors Pease, Kenney, Ebbets, Roberts and Scott voting against its passage to print. On July 6th, after consideration, the resolution was lost, on final passage; Supervisors Menzies, Sims, Block, Hewston, Lynch and Macdonald voting for, and Supervisors Pease, Kenney, Ebbets, Deering, Roberts and Scott voting against its final passage. At the next meeting, held on July 12th, separate resolutions were introduced by Supervisor Lynch, embracing and declaring it to be expedient and proper to acquire the several sources, etc., of water supply named, which, after discussion, were not passed. The following is the vote had on each of the propositions referred to, on the motion of Supervisor Lynch to pass the resolutions to print. Supervisor Block absent:

Clear Lake—Supervisors Menzies, Sims, Hewston and Lynch voting for, and Supervisors Pease, Kenney, Ebbets, Deering, Roberts, Scott and Macdonald, against.

Pescadero Creek—Supervisors Pease, Sims, Hewston and Lynch voting for, and Supervisors Menzies, Kenney, Ebbets, Deering, Roberts, Scott and Macdonald, against.

Laguna de la Merced—Supervisors Menzies, Pease, Sims, Hewston, Lynch and Macdonald voting for, and Supervisors Kenney, Ebbets, Deering, Roberts and Scott, voting against.

Blue Lakes—Supervisors Sims, Hewston, Lynch and Macdonald voting for, and Supervisors Menzies, Pease, Kenney, Ebbets, Deering, Roberts and Scott, against.

On July 26th, 1875, the Special Committee on Water Supply, by Supervisor Deering, presented the following supplemental report on Spring Valley and Calaveras sources of water supply:

SECOND SUPPLEMENTAL REPORT.

To the Honorable the Mayor and Board of Supervisors
of the City and County of San Francisco:

Gentlemen—Having discharged the duties assigned me as Engineer appointed by your Board to examine certain designated sources of water supply, any one of which might hereafter be deemed advisable to acquire to furnish the City and County of San Francisco with pure fresh water, and as the surveys, estimates, and report upon the same have been made and submitted, I desire to deliver to your Honorable Body the property belonging to the city, consisting of instruments, camp and office equipments, and in doing so, respectfully tender my resignation, to take effect on the first of August next.

So much has been said by the press and private parties opposed to the Calaveras water scheme, recommended by me, that your Honorable Board will undonbtedly expect your Engineer, about retiring from office, to make a supplemental report, that may throw any light upon the water question. and be of service to the Commissioners and your Board, in disposing of it. With that view, I have carefully considered the reviews, criticisms, and objections urged against the Peninsnla and Calaveras water schemes, and have, with like care, reviewed the whole snbject of my report, bnt have failed, in any degree, to discover any admissible points made by the futile arguments and pains-taking estimates, intended to disprove the report, or the facts therein contained.

It recently devolved upon your Engineer, and First Assistant Allardt, to accompany the Commissioners on their tonr of exploration and investigation on the Peninsula and the Calaveras, looking to the purchase of the Spring Valley Water Works, which, in the opinion of the Engineer, are the two natural sources of supply from which to obtain abundance of water for this city: bnt as the Spring Valley Water Works alone, at present, are to be considered, that snbject will be treated first, and the Calaveras afterward.

From want of time and pressure of business, the details with regard to the supplies and construction of the Spring Valley Water Works were not prepared for the Engineer's first report. It was not then known how much more water would be acquired by those works; but it was said, that if all on the Peninsula was collected and utilized the supply would be large. Since then the full resources of the works have been made public by the reports of the President and Engineer of the company. In addition to the water supplies and property owned and controlled by the company since my first report was made, the Company has included the contiguous watersheds and streams lying between the San Gregorio and Pilarcitos on the Ocean slope of the Peninsula; and also the inland Calaveras, now made tribntary to, and part of the Spring Valley Water Works, as shown in a plan recently reported to the company by Mr. H. Schussler, their Engineer.

Within the compass of the works proposed, an ample and unfailing supply of pure and unexceptionable water may be furnished San Francisco, with five times its present population. Nothing here said is assumed, as all opinions and estimates are based upon facts, actual observation, and experience, and I desire in that connection to state that in the investigations, surveys, and inquiries which have been made with regard to the sources and water supplies on the Peninsula, I am indebted to Mr. Schnssler for valuable statistical information, the result of practical experience running throngh a period of eight years. It is proper, however, to mention that his ratio of the utilization of rainfall, being 35 per cent. of that falling on a given area, is adopted in all compntations of the peninsnla supply.

Referring to the last annual report of the Spring Valley Water Company, it appears from their records that the available annual supply of the present works is 3,628,000,000 gallons, a quantity somewhat larger than

estimated by Mr. Schussler, as it accounts for losses sustained by water now running to waste; but it is available, and will undoubtedly be utilized. The annual supply from 39 square miles of watershed with 40 inches of rainfall due the Crystal Springs reservoir when finished, is 9,488,000,000 gallons, and that due the San Gregorio, with a watershed of 30 square miles and a rainfall of 45 inches, is 8,275,000,000 gallons. This embraces all the gravitation supplies on the peninsula at present owned and controlled by the Spring Valley Water Company. The last named supply will be derived from the sources of the San Gregorio and intermediate streams by a proposed line of aqueduct and tunnels extending to the Crystal Springs reservoir. The aggregate of all the supplies furnished by gravitation is therefore 21,391,000,000 gallons per annum, to which add the 730,000,000 gallons furnished by the Lobos Creek pumping works, making a total annual supply of 22,121,000,000 gallons. But this does not embrace all the available sources. There is a watershed on the ocean slope of the peninsula, adjacent to and below that described and controlled by the Spring Valley Water Company, namely, a belt of land bounded on the east by the aqueduct and tunnel line, on the west by the ocean, and extending from San Gregorio Creek to Pilarcitos Creek. Its area is 47 square miles, average rainfall 45 inches, and the annual supply, available by *pumping*, of 12,864,000,000 gallons.

To utilize this large pumping supply, it is proposed to build an open, intercepting aqueduct, commencing on the San Gregorio and running parallel to and distant about one mile from the ocean shore, and extending northerly to Pilarcitos Creek, near Spanishtown. By means of dams, side branches, and headworks, the waters from intermediate streams will be led into the intercepting aqueduct, the whole to be conveyed to a capacious storage reservoir on the Pilarcitos, of sufficient capacity to hold a year's supply. The dam for this purpose would be raised to a height sufficient to back the accumulated waters to the foothills at a point suitable for pumping the water into a tunnel discharging into Crystal Springs reservoir. As no accurate surveys were made in connection with this project, the estimates of cost are omitted, the object being merely to show the feasibility of the scheme and the extent of the available supply on the peninsula by gravitation and pumping combined. The resources of the Spring Valley Water Works, as now enlarged and described, are then as follows:

By the present works, per annum, by gravitation.....	3,628,000,000 gallons.
By works in progress, Crystal Springs, by gravitation..	9,488,000,000 gallons.
By contemplated works, San Gregorio, by gravitation..	8,275,000,000 gallons.
Total per annum, by gravitation.....	21,391,000,000 gallons.
By pumping works at Lobos Creek, per annum.....	730,000,000 gallons.
By proposed ocean slope pumping works, per annum..	12,864,000,000 gallons.
Total by gravitation and by pumping.....	34,985,000,000 gallons.

This total of peninsula supply is exclusive of Pescadero (which is available

and undoubtedly will, in time, be used), and is equal to 96,000,000 gallons per diem. But as pumping on the peninsula, as elsewhere, would be found expensive and burdensome, it would be policy and good economy, before attempting to pump water from the ocean slope, to adopt the gravitation supplies of the Calaveras, now belonging to the Spring Valley Water Company. The expense of raising 12,864,000,000 gallons annually, 250 feet high, and discharging the same into the Crystal Springs reservoir, would be $798,211.20, computed on the basis of 17 cents per 1,000,000 gallons raised one foot high (price of coal delivered $15 per ton), whereas a much larger quantity, viz.: 29,087,000,000 gallons, could be brought from the Calaveras to the Crystal Springs reservoir by gravitation, at an annual expense not exceeding $10,000, comprising salaries of reservoir keepers, section men, and supervision, the first cost of construction not being considered in either case; though it is evident that the ocean slope aqueduct and pumping works would cost more than the Calaveras works. This comparison clearly shows the great economy of gravitation over pumping works, and proves the wise policy and great saving to the city of securing the Calaveras supply. The only argument in favor of first obtaining the Spring Valley Works being, that they are already in operation and supply water which may be furnished at reduced rates to the citizens until the works are enlarged, or extended to other sources.

By gravitation alone, the united supplies of the Spring Valley and Calaveras schemes would furnish 50,478,000,000 gallons annually, or 138,000,000 gallons per diem, sufficient for a population of 1,380,000, or 100 gallons daily to every man, woman and child. The capacity of the Spring Valley reservoirs, as proposed and completed, will be about 48,000,000,000 gallons, and that of the Calaveras reservoir, according to your Engineer's report, 34,589,000,000 gallons, giving an aggregate storage capacity of 82,589,000,000 gallons. Works of such character and capacity, so near at home, almost in sight and everywhere accessible, and the cheapest and best that can be had, will certainly be appreciated by the disinterested and impartial people of San Francisco.

It is here proper to add that in making examinations of the Spring Valley Water Works, in company with the Commissioners, the works were critically inspected, and found in successful operation and good repair. With regard to the general character of the works, their performance and construction, they appear in all respects well designed, and the work on them faithfully executed. For supply of excellent water, simplicity, utility, and efficiency, the Spring Valley Water Works will compare favorably with any in the country.

But the gravitation supplies here enumerated, within reach and easy access, are not all that may be obtained. Recent explorations and surveys have disclosed the fact that an extensive watershed, adjacent to and lying east of the Calaveras, embracing San Antonio Creek, Arroyo Valle and Arroyo Mocho, may be acquired, and largely increase the supplies of the Calaveras, to which they would be conveyed by aqueduct, and all made tributary to the Spring Valley Water Works.

The route of the proposed aqueduct would be as follows: Beginning at a point on the Arroyo Mocho near the corner to sections 5, 6, 7 and 8, in Township 4 south, Range 3 east, at an elevation of 942 feet above city base; thence southerly by tunnel 8,200 feet; thence by open aqueduct 14,687 feet to a dam across the Arroyo Valle; thence by open aqueduct along the westerly slopes of the Arroyo Valle 22,795 feet; thence southwesterly by tunnel 9,845 feet to the watershed of San Antonio Creek; thence westerly, by open aqueduct and two tunnels of 760 and 1,400 feet length, crossing the several forks of San Antonio Creek, 80,000 feet to the easterly slopes of Calaveras Creek; thence by open aqueduct southerly and southeasterly along the easterly slopes of Calaveras Creek, 55,034 feet to the proposed timber dam on the Arroyo Honda, heretofore referred to in this report. Total distance, 191,503 feet, or 36.27 miles; grade of aqueduct and tunnels 4 feet to the mile. Thence by open aqueduct, already estimated for, 18,000 feet to the Calaveras reservoir.

The watershed tributary to this line of aqueduct comprises an area of 189 square miles, which added to that of the Calaveras, gives a total of 329 square miles. It is estimated that the ratio of rainfall on the 189 square miles will average about three-fourths of that falling at Calaveras Valley, or 17.9 inches per annum. Assuming the minimum utilization at 35 per cent., or 6.2 inches, the 189 square miles will yield 20,500,000,000 gallons per annum. Add to this the 29,000,000,000 gallons of the Calaveras proper, and the 21,391,000,000 gallons of the Spring Valley or peninsula supply, and we have a grand total of 70,891,000,000 gallons per annum, or an average available supply of 190,000,000 gallons per diem.

Estimate of Cost.—The cost of the above described aqueduct and tunnels was approximately determined by comparison with similar works already estimated upon in the report on the Clear Lake and Blue Lakes schemes, and found to be as follows:

20,205 lineal feet of tunneling, at $25	$505,125
171,300 lineal feet of open aqueduct, at $3.10	531,030
	$1,036,155
Add ten per cent. for contingencies and engineering	103,615
Total cost	$1,139,770

Percentage of Utilization. — The percentage of utilization of rain and snowfall on the watershed of the Calaveras was definitely settled during the past season by careful measurements, not alone of the utilization due to the lower valley and site of the main storage reservoir, but that due to the rain and snowfall on the entire watershed of 140 square miles, with altitudes ranging from 600 to 4,000 feet. It was observed in taking the measurements that the maximum outflow in one day was 3,360,980,000 gallons. It is evident from this result that much heavier rain and snowfall prevail on the up-

per slopes of the Calaveras watershed than at the valley below, but the average of the higher and lower appears to correspond very nearly with the mean rainfall at San Francisco.

As evidence of the quantity and ample supply of water from this source, I desire to call your attention to the following carefully prepared tables, which will serve to establish plain self-evident facts, and refute the assertions and arguments by which the engineer's report has been so unjustly and wantonly assailed.

TABLE I—RAINFALL IN CALAVERAS VALLEY.

DATE.	RAINFALL.
October 20th, 1874	0.87 inches.
October 22d, 1874	1.03 "
October 24th, 1874	1.66 "
October 27th, 1874	0.54 "
November 5th, 1874	1.36 "
November 8th, 1874	0.05 "
November 18th, 1874	0.39 "
November 23d, 1874	2.62 "
November 24th, 1874	0.15 "
December 15th, 1874	0.09 "
December 25th, 1874	0.09 "
January 14th, 1875	0.52 "
January 15th, 1875	0.72 "
January 16th, 1875	0.74 "
January 18th, 1875	0.39 "
January 19th, 1875	1.26 "
January 20th, 1875	0.16 "
January 22d, 1875	0.14 "
January 23d, 1875	0.90 "
January 24th, 1875	0.48 "
January 25th, 1875	0.38 "
February 1st, 1875	0.27 "
February 16th, 1875	0.14 "
February 17th, 1875	0.18 "
March 2d, 1875	0.86 "
March 4th, 1875	0.18 "
March 5th, 1875	0.06 "
March 17th, 1875	0.05 "
March 24th, 1875	0.12 "
March 25th, 1875	0.20 "
March 28th, 1875	0.44 "
Total	17.04 inches.

TABLE II.—DAILY DISCHARGE OF CALAVERAS CREEK FROM DECEMBER 2, 1874 TO MARCH 31, 1875, INCLUSIVE.

DATE.	DISCHARGE.	DATE.	DISCHARGE.
December 2, 1874.....	23,470,000 gallons.	February 1, 1875.....	113,993,000 gallons.
" 3, 1874.....	23,470,000 "	" 2, 1875.....	113,993,000 "
" 4, 1874.....	23,470,000 "	" 3, 1875.....	113,993,000 "
" 5, 1874.....	23,470,000 "	" 4, 1875.....	83,954,000 "
" 6, 1874.....	23,470,000 "	" 5, 1875	69,754,000 "
" 7, 1874.....	23,470,000 "	" 6, 1875.....	50,255,000 "
" 8, 1874.....	23,470,000 "	" 7, 1875 ..	50,255,000 "
" 9, 1874.....	23,470,000 "	" 8, 1875.....	41,842,000 "
" 10, 1874.....	23,470,000 "	" 9, 1875.....	41,842,000 "
" 11, 1874.....	23,470,000 "	" 10, 1875.....	41,842,000 "
" 12, 1874.....	23,470,000 "	" 11, 1875.....	41,842,000 "
" 13, 1874.....	23,470,000 "	" 12, 1875.....	41,842,000 "
" 14, 1874.....	23,470,000 "	" 13, 1875.....	41,842,000 "
" 15, 1874.....	23,470,000 "	" 14, 1875.....	41,842,000 "
" 16, 1874.....	23,470,000 "	" 15, 1875.....	32,144,000 "
" 17, 1874.....	23,470,000 "	" 16, 1875.....	32,144,000 "
" 18, 1874.....	23,470 000 "	" 17, 1875.....	32,144,000 "
" 19, 1874.....	23,470,000 "	" 18, 1875.....	32,144,000 "
" 20, 1874.....	23,470,000 "	" 19, 1875.....	32,144,000 "
" 21, 1874. ..	23,470,000 "	" 20, 1875.....	32,144,000 "
" 22, 1874.....	23,470,000 "	" 21, 1875.....	32,144,000 "
" 23, 1874.....	23,470,000 "	" 22, 1875.....	32,144,000 "
" 24, 1874.....	23,470,000 "	" 23, 1875.....	32,144,000 "
" 25, 1874.....	23,470,000 "	" 24, 1875.....	32,144,000 "
" 26, 1874.....	23,470,000 "	" 25, 1875.....	29,668,000 "
" 27, 1874.....	23,470,000 "	" 26, 1875.....	29,668,000 "
" 28, 1874.....	23,470,000 "	" 27, 1875.....	29,668,000 "
" 29, 1874.....	23,470,000 "	" 28, 1875.....	29,668,000 "
" 30, 1874.....	23,470,000 "		
" 31, 1874.....	23,470,000 "		
January 1, 1875.....	23,470,000 "	March 1, 1875.....	29,668,000 "
" 2, 1875.....	23,470,000 "	" 2, 1875.....	29,668,000 "
" 3, 1875	23,470.000 "	" 3, 1875.....	29,668,000 "
" 4, 1875.....	23,470,000 "	" 4, 1875.....	29,668.000 "
" 5, 1875.....	23,470,000 "	" 5, 1875.....	29,668,000 "
" 6, 1875.....	23,470,000 "	" 6, 1875.....	29,668,000 "
" 7, 1875.....	23,470,000 "	" 7, 1875.....	29,668,000 "
" 8, 1875	23,470,000 "	" 8, 1875..	29,668,000 "
" 9, 1875.....	23,470,000 "	" 9, 1875.....	29,668.000 "
" 10, 1875.....	19,461,000 "	" 10, 1875	29,668,000 "
" 11, 1875	19,461,000 "	" 11, 1875.....	29,668.000 "
" 12, 1875.....	19,461,000 "	" 12, 1875.....	29,668,000 "
" 13, 1875.....	19,461,000 "	" 13, 1875.....	29,668,000 "
" 14, 1875.....	23,470,000 "	" 14, 1875.....	29,668.000 "
" 15, 1875.....	605,247,000 "	" 15, 1875.....	29,668,000 "
" 16, 1875.....	239,421,000 "	" 16, 1875.....	26,336.000 "
" 17, 1875.....	385,744,000 "	" 17, 1875.....	26,336,000 "
" 18, 1875.....	169,078,000 "	" 18, 1875.....	26,336,000 "
" 19, 1875.....	3,300,968,000 "	" 19, 1875.....	26,336,000 "
" 20, 1875.....	994,580,000 "	" 20, 1875.....	23,470,000 "
" 21, 1875.....	316,215,000 "	" 21, 1875.....	23,470,000 "
" 22, 1875.....	358,293,000 "	" 22, 1875.....	23,470,000 "
" 23, 1875.....	358,293,000 "	" 23, 1875.....	23,470,000 "
" 24, 1875.....	545,865,000 "	" 24, 1875.....	23,470,000 "
" 25, 1875.....	431,542,000 "	" 25, 1875.....	23,470,000 "
" 26, 1875....	264,988,000 "	" 26, 1875.....	23,470,000 "
" 27, 1875.....	245,013,000 "	" 27, 1875.....	23,470,000 "
" 28, 1875.....	245,013,000 "	" 28, 1875...	23,470,000 "
" 29, 1875.....	238,768,000 "	" 29, 1875.....	23,470,000 "
" 30, 1875.....	239,421,000 "	" 30, 1875.....	23,470,000 "
" 31, 1875.....	171,517,000 "	" 31, 1875.....	23,470,000 "

Total discharge in 120 days, 12,347,817,000 gallons.

TABLE III.—CALAVERAS RESERVOIR AND WATERSHED.

Exhibiting its capacity and water supply based on the rainfall at San Francisco for the last 25 years at 50 per cent. utilization and assuming that 50,000,000 gallons are drawn each day from the reservoir.

SEASON.	Rainfall in Inches.	Average daily excess over 50,000,000 gallons.	Average daily deficiency under 50,000,000 gallons.	In the Reservoir at the end of each rainy season.	Surplus in Reservoir after 50,000,000 per day have been drawn.
1849–50.....	33.10	59,000,000	.....	34,590,000,000	16,340,000,000
1850–51.....	7.40	....	27,000,000	24,735,000,000	6,485,000,000
1851–52.....	18.44	9,000,000	.....	28,020,000 000	9,770,000,000
1852–53.....	35.26	66,000,000	.....	34,590,000,000	16,340,000,000
1853–54.....	23.87	26,000,000	.....	34,590,000,000	16,340,000,000
1854–55.....	23.68	26,000,000	.....	34,590,000,000	16,340,000,000
1855–56.....	21.66	19,000,000	.....	34,590,000,000	16,340,000,000
1856–57.....	19.81	13,000,000	....	34,590,000,000	16,340,000,000
1857–58.....	21.88	19,000,000	.....	34,590,000,000	16,340,000,000
1858–59.....	22.22	23,000,000	.....	34,590,000,000	16,340,000,000
1859–60.....	22.27	23,000,000	.....	34,590,000,000	16,340,000,000
1860–61.....	19.72	13,000,000	.....	34,590,000,000	16,340,000,000
1861–62.....	49.27	115,000,000	.....	34,590,0(0,000	16,340,000,000
1862–63.....	13.62	.....	7,000,000	32,035,000,000	13,785,000,000
1863–64.....	10.08	.....	17,000,000	25,830,000,000	7,580,000,000
1864–65.....	24.73	29,000,000	.....	34,590,000,000	16,340,000,000
1865–66.....	22.93	23,000,000	.....	34,590,000,000	16,340,000,000
1866–67.....	34.92	62,000,000	.....	34,590,000,000	16,340,000,000
1867–68.....	38.84	76,000,000	.....	34,590,000,000	16,340,000,000
1868–69.....	21.35	19,000,000	....	34,590,000,000	16,340,000,000
1869–70.....	19.31	13,000,000	....	34,590,000,000	16,340,000,000
1870–71.....	14.10	.....	4,000,000	33,130,000,000	14,880,000,000
1871–72.....	34.71	62,000,000	.....	34,590,000,000	16,340,000,000
1872–73.....	18.02	9,000,000	.....	34,590,000,000	16,340,000,000
1873–74.....	23.98	26,000,000	.....	34,590,000,000	16,340,000,000

DESCRIPTION OF TABLES.

Table I—Gives the rainfall in Calaveras Valley from October 20, 1874, to March 28, 1875, inclusive, as determined by a rain gauge kept at the site of the proposed reservoir. The total rainfall was 17.04 inches, as against 17.22 inches of rainfall at San Francisco during the same period.

Table II—Shows the daily outflow or discharge of Calaveras Creek ascertained by instrumental measurements and daily observations on a carefully established water gauge near the site of the reservoir. The record embraces a period of four months, from December 2, 1874, to March 31, 1875, and gives a total discharge of 12,347,000,000 gallons, or an average exceeding one hundred million gallons per day. The rainfall during that time amounted to 8.37 inches. A simple calculation will show that over 60 per cent. of the rainfall on the 140 square miles of catchment area of the Calaveras was actually discharged. It follows that had the dam been built, this 60 per cent. of rain would have been retained and stored in the reservoir; but in order to

be entirely on the safe side, only fifty per cent. was adopted in the report as the percentage of utilization, leaving 10 per cent. of the entire rainfall to cover evaporation from the surface of the reservoir, which somewhat exceeds 8 inches per month during the dry season.

Table III—Exhibits the amount of water that would be contained in the reservoir during a consecutive series of years, based on the rainfall at San Francisco for the past twenty-five years; and assuming that the reservoir would be full at the start, and that 50,000,000 gallons would be drawn out daily. It will be seen that even after the driest season on record, there would have been a surplus of 6,485,000,000 gallons in the reservoir.

In taking leave of your Honorable Body, I respectfully request permission be granted First Assistant Allardt, and the employees now engaged in the office, to remain and complete the unfinished work on the maps and plans, which will require most of the coming month. Whatever service of mine may be necessary by way of attention or advice in the execution of this work, will be rendered without charge. These maps and plans have been so far prepared with care, and when finished will be of great value by way of reference and guidance in the future.

Respectfully submitted,

T. R. SCOWDEN,
Chief Engineer City Water Supply.

San Francisco, July 26, 1875.

The following report of the Committee, consisting of the Mayor, Auditor and City and County Attorney, as to their examination of the property belonging to the Spring Valley Water Works, and the price at which said company would sell and convey the same to the city and county, was presented to the Board on July 30th, 1875, at a meeting convened by his Honor, Mayor Otis, for that purpose:

Mayor's Office,
San Francisco, July 30th, 1875.

To the Hon. the Board of Supervisors of the City and County of San Francisco:

Gentlemen—Under Act of the Legislature of the State of California, authorizing the City and County of San Francisco to provide and maintain public water works for said city and county, and to condemn and purchase private property for that purpose, approved March 30th, 1874, and acting under resolution of your Honorable Board (No. 7448,) relative thereto, the Committee named in said Act—the Mayor, Auditor and City and County Attorney, beg leave to report:

That in accordance with the requirements of said Act, they have visited the works of the Spring Valley Water Works, and made a careful and per-

sonal examination of the same, assisted by the Engineer and assistant on the part of the city, together with the President, Engineer, and Superintendent of Construction of the Company.

We found the works in efficient order, manifesting skill and ability in their construction, and economy and fidelity in their management. After further examination into the cost and expenses incumbent upon the management of the works, and several interviews and consultations with the President and Engineer of the company, on the 22d instant we addressed a letter to the President of the company (copy of which herewith), asking him to name the lowest price which the company proposed to take for their entire property, and requesting at the same time that he furnish us a schedule of the same, to which, on the 26th instant, he replied (copy herewith, with schedule) in this letter: the price named for the property known as the Spring Valley Water Works, proper, as per schedule, is fourteen million five hundred thousand dollars, to be free and clear of all encumbrances. For the Calaveras property the sum of one million dollars is named. This was a higher figure than the Committee had anticipated, and after still further examination into the cost of the construction of the works, expenses and revenue, on the 29th we again addressed a communication to the President of the company (copy enclosed), requesting a statement of the monthly or annual expenses of the management, and also asking him if he was disposed to name any lower price, to which he replied this day (as herewith), stating expenses in round numbers to be one hundred thousand dollars per annum, and that he was not disposed to name any lower price.

Thereupon, upon further consideration and further consultation, the Committee decided not to accept the terms offered, and are obliged to report to your Honorable Board that we cannot agree upon the price. We have delayed making any report, under the hope that the company might so shape its action in the matter of purchase money that a negotiation might be effected, and, under your approval, the people be allowed to express their opinion at the next general election in September.

We decline the offer, on the ground that the price named is much in excess of the true cost of the works, as shown by their own books; and also in excess of real value to-day. Also that the amount named is but a portion of the real sum necessary to provide the annual and daily supply, as estimated in the report of their Engineer, as well as in that of Mr. Scowden. To make available all the sources of supply set forth in their several reports, an estimated expenditure of seven millions of dollars would be required, making a total of twenty-two millions five hundred thousand dollars, which, before completion, with renewal of pipes and aqueducts, would not fall short of twenty-five millions, or more.

We believe it would be in the interest of the people that still further inquiries and explorations should be made, as to other sources of supply, the short time allowed not having been long enough for a proper and thorough search for water in never-failing abundance, and of good quality.

We believe, however, that some restrictions should be, by legislative action, placed upon the private company, not only as to rates, as to proper pipes in all streets to properly supply us in case of fire; also to furnish necessary water for flushing sewers, watering streets, as well as to an extension of pipes to supply the whole population.

We believe, however, in the principle that the city, in proper time, should own and have control of its own water works; that water should be provided to all; that to the poor, or those who cannot pay, it should be given free, if from sanitary motives only.

For all statistics as to the various sources of supply, and more particularly as to that of the Spring Valley Water Works, we would refer to the reports of the City Engineer, Mr. Scowden, and to the accompanying report of the officers of the Spring Valley Company.

We have the honor to remain,

JAMES OTIS, Mayor.
MONROE ASHBURY, Auditor.
W. C. BURNETT, City and County Attorney.

The following is the correspondence, schedule of property, the reports of the President, Chief Engineer, Superintendent and Secretary of the Company referred to in and accompanying the foregoing report :

SAN FRANCISCO, July 22, 1875.

To CHARLES WEBB HOWARD, ESQ., *President of the Spring Valley Water Works, and to the Board of Directors thereof :*

GENTLEMEN—The Committee, consisting of the Mayor, Auditor, and City and County Attorney of the city and county of San Francisco, acting pursuant to the provisions of the Act of the Legislature of the State of California, entitled "An Act to authorize the city and county of San Francisco to provide and maintain public water-works for said city and county, and to condemn and purchase private property for that purpose," approved March 30, 1874, and of a resolution of the Board of Supervisors of said city and county, numbered seven thousand four hundred and forty-eight (7,448), of which resolution a printed copy is attached hereto, as follows, viz : [here follows the resolution] invite you to communicate in writing to said Committee a statement of the lowest price at which the Spring Valley Water Works will sell and convey unto said city and county the property contemplated by such resolution to be purchased. The Committee deem it important that a full and detailed description of the property offered for sale should be attached to such communication. Inasmuch as it has been hinted to the Committee that the Spring Valley Water Works claim to have owned the Calaveras property at the time of the introduction and passage of said resolution, which property is mostly situated in Santa Clara county, and the Committee has no power to negotiate a contract with respect to the purchase of any property in that county, except for the purpose of laying down and maintaining mains or water pipes, the Committee earnestly request you to name the price at which the Water Company will sell such property as is contemplated by said resolution, exclusive of the Calaveras property.

Respectfully,

JAMES OTIS,
Chairman of said Committee.

SPRING VALLEY WATER WORKS,
SAN FRANCISCO, July 26, 1875.

Hon. James Otis, Chairman of the Committee to Provide Water Works for City and County of San Francisco:

MY DEAR SIR—I have to acknowledge the receipt of your communication of the 22d inviting me to communicate in writing to your Committee a statement of the lowest price at which the Spring Valley Water Works will sell and convey to the city and county of San Francisco its property as contemplated in the resolution of the Board of Supervisors of said city and county, No. 7,448, and in reply thereto I have to say that the Spring Valley Water Works will sell the same for $14,500,000, with the understanding that the city shall fulfill all of the obligations of the Spring Valley Water Works for supplying water. We will also include the Calaveras property, if desired, for the sum of $1,000,000 additional. I submit herewith a detailed statement and description of the properties, both of the Spring Valley and Calaveras projects.

Respectfully,

CHARLES WEBB HOWARD,
President Spring Valley Water Works.

SAN FRANCISCO, July 26th, 1875.

SCHEDULE OF THE PROPERTY

Which the Spring Valley Water Works propose to sell to the City of San Francisco, in accordance with the terms of the foregoing letter from the President of said corporation to Hon. James Otis, Chairman of the Committee on behalf of said city and county:

I.—FRANCISCO STREET RESERVOIR PROPERTY.—Consisting of 50-vara lots Nos. 1,161, 1,160, 1,346, 1,347, 1,436, and 1,435, and forming the block bounded by Francisco, Hyde, Bay, and Larkin streets; also, 50-vara lots Nos. 1,252, 1,345, and 1,434, the same forming the northerly half of the block bounded by Chestnut, Hyde, Francisco, and Larkin streets.

II.—LOMBARD RESERVOIR PROPERTY.—Which consists of six 50-vara lots, namely: Nos. 776, 777, 778, 779, 780, and 781, and forms the entire block bounded by Greenwich, Hyde, Lombard, and Larkin streets.

III.—THE POINT LOBOS PUMPING WORKS.—Consisting of two 50-vara lots, namely: 50-vara lot No. 4, southeast corner of Van Ness avenue and Beach street; 50-vara lot No. 3, northeast corner of Van Ness avenue and Beach street, together with all the machinery connected therewith, including the wharf in front thereof.

IV.—PROPERTY CONTAINING THE PIPES CONNECTING THE PUMPING WORKS WITH THE ABOVE NAMED RESERVOIRS.—Consisting of five 50-vara lots, to-wit: 50-vara lots numbered 2, 3, and 4, in the block bounded by Francisco, Larkin, Chestnut, and Polk streets; 50-vara lot No. 6, on the southwest corner of Larkin and Chestnut streets, and 50-vara lot No. 804, on the northeast corner of Lombard and Larkin streets.

V.—THE CLAY STREET HILL RESERVOIR PROPERTY.—Consisting of the 50-vara lot on the northeast corner of Washington and Jones streets.

VI.—THE MARKET STREET RESERVOIR PROPERTY.—Consisting of seventeen 50-vara lots, more or less, bounded by Kate, Buchanan, Church, and Market streets; also, of a lot, 25x100 feet, on the southeast corner of Buchanan and Kate streets.

VII.—BRANNAN STREET RESERVOIR PROPERTY.—Consisting of the entire block No. 65, and bounded by Potrero avenue, Center, Santa Clara, and Jersey streets.

VIII.—COLLEGE HILL RESERVOIR PROPERTY.—Consisting of a lot 534x640 feet, and containing 18 50-vara lots, situate at the northwest corner of West avenue and Park avenue.

IX.—OFFICE PROPERTY.—Being lot on the north side of California street, commencing 137 feet 6 inches west of Montgomery street, thence west 22 feet 3 inches by 137 feet 6 inches deep.

X.—MARIN COUNTY PROPERTY.—Those certain lots situate in the town of Old Sancelito, described as follows: lots numbered 11, 12, 13, and 14, in block No. 6; lots numbered 16 and

17, in block No. 10; lots numbered 6, 7, 16, and 17, in block No. 14; and lots numbered 3, 4, 5, 11, 12, and 13, in block No. 16, as shown on the map of said town of Saucelito, surveyed by Lieutenant Emmens, of the U. S. N., June 8th, 1851.

XI—Lake Honda Property.—Consisting of 63 acres, more or less, and described as follows: starting at corner post No. 24, which stands at the junction of the courses No. 24 and 25 of the San Miguel Ranch survey, thence north 54 degrees and 20 minutes east 7 chains and 20 links; thence south 44 degrees and 20 minutes east 25 chains and 34 links; thence south 75 degrees and 30 minutes west 16 chains and 60 links to a post marked "A"; thence north 44 degrees and 30 minutes west 13 chains and 24 links; thence north 18 degrees and 30 minutes east 8 chains and 10 links, being the main reservoir tract.

Another tract commencing at the same corner post No. 24, thence north 45 degrees and 30 minutes east 11 chains and 30 links; thence north 22 chains and 60 links; thence south 89 degrees and 15 minutes west 11 chains, more or less, to a fence; thence south 36 chains and 79 links; thence north 18 degrees and 30 minutes east 8 chains and 10 links to the point of beginning, containing about 30½ acres, and designated as the waste pond tract.

Another tract commencing at a point on the southern boundary line of the reservoir tract proper, being 1 chain and 66 links, more or less, easterly from the corner post marked "A," above referred to, thence running north 75 degrees and thirty minutes east 3 chains; thence south 12 degrees and 15 minutes east 9 chains and 36 links; thence south 75 degrees and 30 minutes west 3 chains; thence north 12 degrees and 15 minutes west 9 chains and 36 links to the place of beginning, containing 2 8-10 acres, and designated as the tunnel outlet tract.

Another tract commencing on the centre line of the main Lake Honda tunnel, 2 chains northerly from the inlet or south end of said tunnel, thence running north 65 degrees east 77½ links; thence south 8 degrees and 15 minutes west 7 chains and 9 links to the middle of the creek; thence south 65 degrees west 1 chain and 55 links along the centre line of said creek; thence north 8 degrees and 15 minutes east 7 chains and 9 links; thence north 65 degrees east 77½ links to the point of beginning, containing 1 acre, and designated as the tunnel inlet tract.

XII.—Lobos Creek Property.—Containing 20 acres, described as follows: commencing at a stone monument bearing south 66 degrees 15 minutes west 9 chains and 8 links from the inlet end, on the border of Mountain Lake and known as Hotalling Tunnel, the said monument constituting the southeast corner of a strip of land 3 chains and 18 links wide, following the meanderings of Lobos Creek, and including both banks thereof, from its head to its mouth at the ocean.

XIII.—Property Situate in San Mateo County—Pilarcitos watershed and reservoir, being a tract of land commonly known as the "Spring Valley Farm," containing 5,334 acres, more or less, and embracing the whole of sections 29, 30, 32, and parts of sections 19, 20, 28, 31, 33 and 34 in Township 4 south, Range 5 west, Mount Diablo base and meridian; parts of sections 3, 4, 5 and 10, in Township 5 south, Range 5 west, same base and meridian; and parts of sections 22, 23, 24 and 25, in Township 4 south, Range 6 west, same base and meridian.

These lands are held under titles acquired direct from the United States or the State of California, and upon them is situate the Pilarcitos Reservoir. Running with the land is also the right to take and divert the waters of the Pilarcitos Creek, acquired by grant from the riparian owners, from the dam down to the sea; also the right of way for the tunnels, flumes, pipes and aqueducts as now established, from the reservoir to the city.

XIV. Lock's Creek Property—This property embraces a tract of land, including 1,150 acres, title acquired in part from the United States and in part from the State of California, and running with it is the right to take and divert the waters of Lock's Creek, acquired by grant from the riparian owners, and the right of way for flume and pipe line, as now established and used for the diversion and appropriation of said waters.

XV.—San Andres Reservoir Property.—This is a tract of land in one compact body, commonly called the San Andres Reservoir Tract, upon which the San Andres lake is situate. It includes something over 1,500 acres, and was acquired, by purchase, in a large

number of small parcels, part of it coming from the different subdivisions of the Purri Burri rancho, part of it from the San Pedro rancho, and part of it from the public domain, through patents from the United States and the State of California. Running with the land is the right from the riparian owners to divert the waters of the San Andres creek, and the right of way for the flumes, pipes and aqueducts, as now established, from the lake to the city.

XVI.—Crystal Springs Reservoir Tract.—Of the real estate necessary to carry out the project for the establishment of the Crystal Springs reservoir, now in the course of construction, this corporation has acquired, and includes in this offer, the title to the following named tracts of land, to wit:

The Sawyer tract (so-called)	2,200 acres
The Spaulding tract	44 95-100 acres
The Mauvias tract	13 acres
The Crystal Spring tract	95 14-100 acres
The Carey tract	135 74-100 acres
The Arguello tract	516 43-100 acres
The Dolan tract	71 acres
The Peyton tract	452 acres
The Bollinger tract	1,171 78-100 acres
The O'Callaghan tract	659 80-100 acres
Total	5,358 89-100 acres

In addition to which the corporation has a contract for the purchase of the Maynard tract, of 496 acres, which will be assigned. To carry out the project, it will be necessary to acquire not exceeding 900 acres more, and for all that it is necessary so to acquire, the corporation now has proceedings pending to condemn.

Note.—The descriptions of the tracts of land in San Mateo county so far mentioned, if given by metes and bounds, as found in our conveyances, would be found too voluminous for any of the purposes for which a description is now needed. We have therefore described them by their common designation and name, adding a statement of quantity and location as above, and will furnish such further description as may be required, when needed, accompanied with our evidence of title.

XVII.—The Sweeney Farm.—This is a tract of land acquired separately from the Spring Valley farm, but situate immediately above it and embracing the sources of the Pilarcitos creek. It contains about 630 acres, and is described as follows: The southwest quarter, the east half of the southeast quarter, the south half of the northeast quarter, the fractional north half of the northeast quarter, and the fractional northwest quarter of section 18; and the fractional southeast quarter of section 7, all in township 4 south range 5 west, Mount Diablo base and meridian.

XVIII.—Abbey Homestead Property.—Lot No. 9, in block No. 11; lot No. 12, in block No. 83; lots No. 4 and 16, in block No. 100; lots No. 7 and 13, in block No. 101; lot No. 10, in block No. 102, and lot No. 2, in block No. 104. These lots are each one hundred feet square, and were purchased in order to get a pipe line through the Abbey homestead property.

XIX.—San Gregorio Water Rights.—The right acquired by grant from the several owners of the lands in the San Gregorio, and of other lands which would be affected thereby, to take and divert the waters of the San Gregorio and Tunitos creeks, and to appropriate said waters for the purpose of supplying the city and county of San Francisco, and the inhabitants thereof, with a right of way across the San Gregorio rancho for the necessary flume, pipe or aqueduct, and to construct and maintain the necessary dams for the diversion of said waters.

CONDUITS.

Lock's Creek line, commencing with a stone dam on Lock's Creek, on the southeast quarter of Section 6, Township 5 south, Range 5 west; thence by a flume 7,050 feet along the southwest bank of said creek; thence by a wrought iron pipe 22 inches in diameter 1,595 feet; thence by a flume along the east bank of said creek 8,100 feet long; thence by a flume 1,300 feet preceded by a wrought iron pipe 22 inches in diameter 1,515 feet long; thence again by a 22-inch wrought iron pipe across Appolonia Creek, the outlet of which pipe is joined by a flume 10,000 feet long, that takes the water of Appolonia Creek at a stone dam about the center of Section 9 in Township 5 south, Range 5 west. From the junction of this flume and pipe a flume continues 2,400 feet long; thence by a 22-inch wrought iron pipe 1,961 feet across M'Peak's Creek; thence by a flume 6,800 feet, and thence by a 22-inch wrought iron pipe 1,662 feet; thence by a flume 3,350 feet; thence by a 22-inch wrought iron pipe across two small gulches, one being 925 and the other 1,170 feet in length, with a short flume between the two 300 feet long; thence by flume 5,850 feet; thence by a 22-inch wrought iron pipe 985 feet across Pilarcitos Creek; thence by a flume 6,500 feet in length to the inlet of Lock's Creek Tunnel, where it joins flume 4,300 feet long, bringing the water from the large stone dam below Pilarcitos Lake; thence through said tunnel, which is 3,200 feet long, lined with brick and cement; thence by a flume 1,265 feet; thence by a 37½-inch wrought iron pipe across San Mateo Creek 1,050 feet; thence by a flume 1,450 feet, thence by a 37½-inch wrought iron pipe 2,614 feet across San Andres Creek; thence by a flume 24,000 feet that discharges into the San Andres Lake.

Side flume at Pilarcitos commences on the west side of the Pilarcitos Creek, at a gulch in Section 3, Township 5 south, Range 5 west, extending five miles in a northwesterly direction, picking up all of the creeks on that slope, and emptying into Pilarcitos Lake, the dam forming Pilarcitos Lake, with its waste weir, gate-house, etc. From this gate-house a tunnel 1,600 feet in length, lined with brick and cement, extends to San Mateo Creek; thence by a flume about 300 feet to inlet of tunnel No. 2, where it is joined by a flume bringing the waters of San Mateo Creek thereto; thence by a tunnel, lined with brick and cement, 3,420 feet in length; thence by a flume 2,900 feet in length, dischargiug into a sand and screen box, from which the Pilarcitos conduit, consisting of a 30-inch wrought iron pipe 68,150 feet in length, takes the water and delivers it into the Ocean House flume, which is 5,350 feet long; thence through a 30-inch wrought iron pipe 900 feet across the Ocean House road and the gulch immediately north of it, to the inlet of the Lake Honda tunnel, which is 2,820 feet long and lined with brick and cement, delivering the water into a large screen tank, from which a 30-inch wrought iron pipe 1,600 feet in length conducts the water to and through Lake Honda, where it has two 16-inch outlets, one for each compartment of the lake; thence through 2,244 feet of heavy 22-inch wrought iron pipe; thence through 9,700 feet of 22-inch cast iron pipe to and along Haight street to the crossing of Fillmore street, where it divides into two pipes, one 16-inch, extending through the higher parts of the Western Addition, to the Russian Hill reservoir, and supplying the entire districts above the same; the other branch running from the crossing of Fillmore and Haight streets to the Market street reservoir.

San Andres dam, waste weir, gate-house, etc., outside of the Lock's Creek line. This reservoir has a feeder consisting of a combined pipe line and flume nearly two miles long, which delivers the surplus water of San Mateo Creek, by means of tunnel No. 2 and the 2,900 feet of flume mentioned in connection with the Pilarcitos line, into the San Andres Lake. The water from the San Andres is taken through the so-called Bald Hill tunnel, which is 2,800 feet long, lined with brick and cement, to a screen tank, from which it is conducted through a 30-inch wrought-iron pipe 6,400 feet to Chenery street, in the Fairmount tract; thence by a 22-inch pipe, with a branch leading and discharging into College Hill reservoir—extending along the Mission Road to its intersection with Valencia street; thence along Valencia to Market, to Potter, where it connects with a lower pipe system, and with Market street reservoir.

The reservoirs in San Francisco are all built in the most substantial manner, and are as follows:

Brannan street reservoir, depth 8 feet, elevation 85 feet, capacity in gallons	400,000
Francisco street reservoir, depth 14 feet, elevation 139 feet, capacity	6,712,000
Lombard street reservoir, depth 22 feet, elevation 306 feet, capacity	3,724,000
Clay street hill reservoir, depth 9 feet, elevation 375 feet, capacity	141,000
Market street reservoir, depth 15 feet, elevation 196 feet, capacity	2,250,000
Laguna Honda reservoir, depth 29 feet, elevation 3,777 feet, capacity	32,918,000
College Hill reservoir, depth 18 feet, elevation 252 feet, capacity	15,006,000
Total capacity of city reservoirs	61,151,000
Pilarcitos reservoir, depth 46 feet, elevation 692 feet, capacity	1,083,121,000
San Andres reservoir, depth 89 feet, elevation 449 feet, capacity	7,000,000,000
Making a total storage capacity of	8,144,272,000

A dam eighty feet high can be built in the Crystal Spring Valley, not more than one-half mile north from the place where the hotel stood, that would make a reservoir that will contain more than twice as much as the Pilarcitos Lake. The upper Crystal Spring reservoir, now in process of construction, when completed, will contain about 15,000,000,000 gallons; the lower Crystal Spring reservoir will contain about 25,000,000,000 gallons, and thus give us a storage capacity of 48,144,272,000 gallons, independent of the Calaveras, which would practically add 40,000,000,000 gallons thereto.

CITY ENGINE AND PUMPS.

The pumping works are situated at Black Point, on the 50-vara lot at the southeast corner of Beach street and Van Ness avenue. The 50-vara lot on the northeast corner of Beach street and Van Ness avenue is used as a wharf for landing coal. The pumping works consist of two condensing engines of 250 horse-power each; four pumps, double acting. Size of engine—40 inch bore, 4 feet stroke; size of pumps—two 14-inch bore, 7 feet stroke, and two 12-inch bore, 5 feet stroke; capacity of pumps, 75 gallons to each revolution of the engine.

BOILERS.

There are four boilers, 52 inches diameter, 15 feet long, sixty-seven 3-inch tubes; steam drums, 3 feet diameter, 4 feet high; evaporative power, 10 36-100 pounds of water for every pound of coal. Smoke-stack is built square and of brick, is 116 feet high. Its inside area is larger at the top than at the bottom, the top being 7½ feet square inside, and the bottom 5 feet. The engines are so arranged that but one is used at a time, and run by two boilers. In fact everything is in duplicate, so that in case of any accident the pumps will not have to be stopped.

CITY PIPES.

The total amount of pipe laid in the city on the 16th day of June, 1875, was as follows: 9,839 feet of 22-inch pipe, 1,202 feet of 20-inch pipe, 23,487 feet of 16-inch pipe, 59,589 feet of 12-inch pipe, 11,293 feet of 10-inch pipe, 133,843 feet of 8-inch pipe, 239,367 feet of 6-inch pipe, 223,196 feet of 4-inch pipe, and 7,487 feet of 3-inch pipe. Total, 779,294 feet, or 147 miles, 3,124 feet.

SUMMARY OF ALL THE PIPE OF THE SPRING VALLEY WATER WORKS.

Cast iron pipe, all sizes	779,294 feet
Pilarcitos pipe line, 30-inch pipe, wrought iron	68,150 feet
San Andres pipe line, 30-inch pipe, wrought iron	64,000 feet
Lake Honda main, 30-inch pipe, wrought iron	2,572 feet

Lake Honda main, 22-inch pipe, wrought iron	3,744 feet
Lock's Creek line, 37½-inch pipe, wrought iron	3,718 feet
Lock's Creek line, 22-inch pipe, wrought iron	11,902 feet
Total	933,380 feet

which is nearly 177 miles. There is about 105 miles of service pipe, making upwards of 281 miles of pipe in use. The pipes are all of the very best quality, being the heaviest used for water.

LOBOS CREEK CONDUIT.

Consisting of a 36-inch cement pipe and tunnel at Fort Point	8,889 feet
Black Point tunnel	2,800 feet
Flume from Lobos creek to Fort Point	12,016 feet
The total length being	23,705 feet

and supplies upwards of 2,000,000 gallons daily.

All the tools, wagons, horses and appurtenances connected with the works ; and also all the right, title and interest of the corporation in and to Mountain Lake and to a strip of land 100 feet wide on each side of Hotailing tunnel, connecting the creek property with the lake, containing 32 acres ; also the right, title and interest of the company to Islais creek and the dam and flume connected therewith.

SEPARATE STATEMENT OF THE PROPERTY OFFERED AS BELONGING TO THE CALAVERAS PROJECT.

The south ½ of the southwest ¼ of Section No. 11; all of Section No. 13; the south ½, and south ½ of the north ½, and the north ½ of the northwest ¼, and the northwest ¼ of the northeast ¼ of Section No. 14; the west ½ of the southwest ¼ of Section No. 15; the southeast ¼ of the southeast ¼ of Section No. 16 ; the northwest ¼ of the northwest ¼, and the east ½ of the northeast ¼, and the southwest ¼ of the northeast ¼ of Section No. 22; the east ½ of the east ½, and the west ½ of the northeast ¼, and the northwest ¼ of the southeast ¼, and the north ½ of the northwest ¼ of Section No. 23; all of Section No. 24; all of Section No. 25; the southeast ¼, and the south ½ of the northeast ¼ of Section No. 26; the north ½ of the northeast ¼, and about 20 acres off the north end of the south ½ of the northeast ¼ of Section No. 35; the north ½ of the north ½, and about 35 acres off the north side of the south ½ of the north ½ of Section No. 36; all in Township No. 5 south, Range No. 1 east Mount Diablo base and meridian.

Also the northwest ¼ of the northwest ¼, and about 10 acres off the north side of the southwest ¼ of the northwest ¼ of Section No. 31, in Township No. 5 south, Range No. 2 east Mount Diablo base and meridian, containing in all about 3,960 acres of land.

Also the Vallejo Mill property, described as follows : being a part of the rancho "Arroyo de Alameda," commencing at a point in the southerly boundary line of said rancho in the Alameda Creek, about three hundred yards above the site of the old Vallejo Mill, where a wire fence met said creek in the year A. D. 1857; thence down said creek, with the meanderings thereof, to a point where another wire fence met said creek, which point is about three hundred feet west of the present travelled road leading from San Leandro to San Jose; thence northerly along said wire fence, or where the same stood in the year 1857, to a stake in or near the line of the present highway; thence in an easterly direction to the place of beginning.

This, although the most valuable single piece of property connected with the Calaveras scheme, has but a small area, and it was necessary to acquire it on account of the water-rights connected with it.

Running with these lands is the right, acquired by deed, as against nearly all the riparian owners who will or can be effected thereby, to take and divert the waters of Alameda Creek and its feeders and tributaries, so far as they can be taken by means of a dam erected on

Section 13 above mentioned, and to appropriate the same for the purpose of supplying the City and County of San Francisco, and the inhabitants thereof. The point of diversion is in the County of Alameda, so that, though the reservoir will extend up into the County of Santa Clara, it is not proposed to divert any of the water of the latter county, but only to take it after it has flowed down in its natural course to the County of Alameda.

To carry out this project, it will never be necessary to acquire more than 440 acres of land in addition to those here offered.

REPORTS

Of the President, Chief Engineer, City Superintendent, and Secretary of the Spring Valley Water Works.

REPORT OF THE PRESIDENT.

To the Stockholders of the Spring Valley Water Works:

Gentlemen—On the fifteenth of December last I was elected and assumed the duties of President of your company.

Its policy since that time has been to protect the works, and make them adequate for the present and future wants of our rapidly growing city, by guarding against droughts, having from two to five years' supply on hand.

To that end we have completed the San Andres dam, which gives us a total storage capacity of more than eight thousand million gallons, in nine different reservoirs, the elevations and capacities of which you will find in the report of the City Superintendent.

We are having a wrought plate 22-inch main manufactured. It will be completed and laid within the coming three weeks, extending from the College Hill Reservoir to and through Valencia, and to and through Market to Potter street, where it will branch into two 12-inch cast iron pipes, one going on down Market, the other going down Potter to and through Mission to Spear street.

We have commenced the building of a dam eighty-six and a half feet high at the Crystal Springs Reservoir. It will be carried up fifty feet this year, resting on a base of five hundred and ninety-three feet, with an outward slope of three to one, and an inward slope of three and a half to one, and thus add fifteen square miles to our watershed, and make a reservoir that will contain seven thousand million gallons, which, with the eight thousand already completed, will give us a storage capacity of fifteen thousand million gallons, in which to store the rainfall of the coming winter.

We will commence the next rainy season with about two thousand million gallons on hand.

The addition of fifteen square miles thereto, as above related, more than doubles our watershed, and puts beyond question the fact that an average rainfall this coming winter will give us a three years' supply.

We will complete the Upper Crystal Springs Reservoir next year, and obtain thereby an additional storage capacity of eight thousand million gallons, making a total of twenty-three thousand millions (upwards of seventy-five millions per day for three hundred days), and an ample supply for four years, allowing for the increased population.

We have two 30-inch mains conveying water to the city from the San Andres and Pilarcitos reservoirs; they have a capacity of twenty-one millions per day. When they become too small for the requirements of the city, we will build a substantial conduit of brick and cement from the Crystal Springs Reservoir to the city, crossing the ravines and gulches

with wrought plate pipes. It will be about thirty miles long, large enough to transport one hundred millions daily, will bring the water into the city at an elevation of one hundred and seventy feet above tide water, from which elevation more than three-quarters of the entire city can be supplied, leaving the Pilarcitos and San Andres waters exclusively for the higher elevations. The completion of this conduit will cost about one million dollars, will give an ample supply for the next twelve years, and enable us to have from four to five years' supply on hand during that time without any further expense for construction.

We will then build the Lower Crystal Springs Dam, which will add ten and six-tenths square miles to our watershed, and make a reservoir that will contain twenty-three thousand million gallons, at a cost of about five hundred thousand dollars. We will then add the fifty miles of watershed connected with the San Gregorio, Purissima, and other streams belonging to the company, by bringing them into the Crystal Springs Reservoir, at a cost not exceeding one million of dollars, and thus put beyond question the capacity of our watershed to so replenish our reservoirs, as that they will, for a great many years, contain from four to five years' supply, allowing for the increased population, and when filled, would contain forty-six thousand million gallons, more than one hundred and twenty-five millions per day for three hundred and sixty-five days.

At the same time being fully impressed with the idea that this is to be a very large city, and that it may grow more rapidly than any of us anticipate, we have thought it advisable to acquire the next most available supply to be found, which is the Calaveras Valley and its one hundred and forty miles of watershed. It is only about twenty-eight miles distant from our Upper Crystal Springs Reservoir, can be effectually connected therewith in two years' time, at a cost of three and one-half million of dollars, so as to add twenty thousand million gallons per annum to our supply, which would then give the works a storage capacity of sixty-eight thousand million gallons, an ample supply for thirty years.

The Croton Water Works, supplying New York city, has a capacity of one hundred and fifteen millions per day, and is supplying one hundred and four millions. It has cost twenty-five million dollars, and on the first day of April last, the Croton water debt outstanding was sixteen million two hundred and seventy thousand one hundred and fifty-five dollars.

Now, by expending six and one-half millions of dollars on our works, during the next twelve or fifteen years, for the completion of the Crystal Springs dam and aqueduct, and bringing in the San Gregorio and other streams, as also the Calaveras, we can obtain a running supply of one hundred and twenty-five millions per day perpetually, and that, too, with a completed water works equal to the best in America.

So much has been said derogatory and abusive, without cause, in relation to the present management of this company, that I deem it not out of place to say that we did not embark in this enterprise for any other purpose than that of obtaining a piece of property at the rate of nine and one-half million dollars, which we thought worth a great deal more money, had cost in the vicinity of fifteen million dollars, would improve in value every year, and would very soon pay a fair rate of interest on its cost.

A careful examination into the affairs of the company after we had made the purchase, confirmed our anticipations concerning its value: they disclose that the money received from assessments, water rents, and all other sources, with simple interest added at the rate of ten per cent. per annum from the time it was received up to the thirty-first day of March, 1875, was twenty-two million four hundred and fifty-eight thousand eight hundred and eighty-three dollars and seventy-nine cents. This sum includes all the money that the San Francisco City Water Works, and the Spring Valley Water Works, had received from all sources on the thirty-first day of March last, including ten per cent. simple interest thereon from the time it was received to that date.

The dividends paid by the said companies, together with interest added at the same rate, from the time they were paid to the said thirty-first day of March last, amounts to six million nine hundred and eighty thousand six hundred and thirty-five dollars and thirteen cents, leaving fifteen million four hundred and seventy-eight thousand two hundred and forty-eight dollars and sixty-six cents as being the actual cost of the works in cash on the said thirty-first day of March, 1875.

My predecessor having in view the fact that our works were soon to require heavy and expensive outlays, very wisely sent our Engineer, Mr. Schussler, on a tour of inspection through the Eastern cities and Europe, to acquire a thorough knowledge of all matters concerning sewerage, paving of streets and everything pertaining to the construction of water-works suitable for supplying a large city with water, so as to enable us to profit by the experience of others who have been engaged in enterprises of this kind on the largest scale. He has nearly completed a very interesting report, which will be printed in a few days, and which I recommend to the careful perusal of every person interested in these subjects. It can be obtained, as also the report of the Secretary and City Superintendent, which are submitted herewith, by application to the Secretary.

REPORT OF H. SCHUSSLER, CHIEF ENGINEER SPRING VALLEY WATER WORKS.

CHARLES WEBB HOWARD, ESQ.,

President Spring Valley Water Works:

MY DEAR SIR—Agreeably with your request I hand you a report on the condition and capacity of the works of the company and their future.

The Spring Valley Water Works, which furnish the city of San Francisco with water, derive their supply from streams situated in the mountains of San Mateo county; they are parallel to the coast and vary in elevation from six hundred to twenty-five hundred feet above the ocean.

The range nearest to the ocean being the highest, its crest forms an eddy when the westerly and southwesterly winds drive the rain-charged clouds over it, thus discharging bountifully into the valleys immediately east of it.

This seems to be the cause of the annual rainfall in these mountains, being nearly one hundred per cent. larger than that in the valley of the bay.

COMPARATIVE RAINFALL.

YEAR.	PILARCITOS.	SAN ANDRES.	SAN FRANCISCO.
1868-69	48.26 inches.	38.57 inches.	21.56 inches.
1869-70	48.21 "	35.70 "	18.53 "
1870-71	38.88 "	30.52 "	15.21 "
1871-72	78.28 "	82.57 "	38.32 "
1872-73	42.19 "	36.26 "	19.80 "
1873-74	50.31 "	47.63 "	28.23 "
1874-75	41.81 "	42.03 "	22.93 "

Being aware of the fact that a district thickly wooded furnishes a more regular supply of water than a barren one, partly on account of its soil longer retaining its moisture, and

partly on account of the ground being shaded, thus diminishing evaporation, the company have made it a rule to retain their forests in their virgin state over their entire watershed.

For the purpose of equally distributing the winter's water over the entire year, a series of reservoirs have been built at different elevations and of different capacities.

When the Crystal Springs Lake is completed the system of the Spring Valley Water Works will be divided into three branches, as follows:

No. 1, UPPER CITY SUPPLY.

PILARCITOS LAKE.

Elevation 696 feet above tide water; capacity, ten hundred and eighty million gallons. It is connected with the city by an aqueduct consisting of three tunnels, lined with brick and cement, having an aggregate length of seventy-eight hundred and seventy feet; sixty-nine thousand three hundred and thirty-six feet of 30-inch wrought iron pipe, and eighty-three hundred feet of flume.

This aqueduct brings the water to the Laguna Honda reservoir, built of mason work and having a capacity of thirty-three million gallons, at an elevation above tide water of three hundred and seventy-seven feet. From here a 22-inch pipe delivers the water to the highest part of the city in the Western Addition.

No. 2, MIDDLE CITY SUPPLY.

SAN ANDRES LAKE.

Elevation four hundred and fifty-five feet above tide water, and a capacity of seven thousand million gallons. It is connected with the city by an aqueduct consisting of three thousand and seventy feet of tunnel, lined with brick and cement, and sixty-four thousand feet of 30-inch wrought iron pipe leading into College Hill reservoir near St. Mary's College.

The elevation of this latter reservoir is two hundred and fifty-three feet, and its capacity fourteen million gallons. The water is carried thence eighteen thousand four hundred and eighty feet to the middle pipe system through a 22-inch pipe, which connects with the Market Street reservoir.

San Andres Lake has the following additional feeders. The Lock's Creek line, seventeen miles in length, composed of thirty-seven hundred and eighteen feet of 37½-inch pipe, eleven thousand nine hundred and two feet of 22-inch pipe, thirty-three hundred feet of tunnel, lined with brick and cement, and the balance being a flume. This aqueduct brings the water of Lock's and Appalonia Creeks and of the lower Pilarcitos into the San Andres Lake. Another feeder to this lake is an aqueduct, one and one-half miles long, and brings the waters of San Mateo Creek through Tunnel No. 2, of the Pilarcitos line.

These two systems—the upper and middle city supply—can be supplemented by two two hundred and fifty horse power engines and four pumps at Black Point, delivering the two million gallons of water per day furnished by the Lobos Creek aqueduct into the two Russian Hill reservoirs.

The daily capacity of the Pilarcitos and the San Andres aqueducts leading into the city is nearly twenty-one million gallons.

No. 3, LOWER CITY SUPPLY.

CRYSTAL SPRINGS LAKE.

Elevation three hundred and five feet above tide water. The capacity of the reservoir now being constructed will be fifteen thousand million gallons. When the lower main dam

is completed, its capacity will be forty thousand million gallons; it is to be connected with a reservoir near the Industrial School, of a capacity of two hundred million gallons, and at an elevation of one hundred and seventy feet above tide water, by an aqueduct, thirty miles in length, having a daily capacity of one hundred million gallons.

A pipe of five feet diameter will conduct the water from this distributing reservoir through the deep railroad cut and along Mission street to the city front, branching off at each crossing, and so supply the entire lower business portion of the city, both north and south of Market street.

CITY PIPE SYSTEM.

For the purpose of distributing the water through the city, there are laid in the streets one hundred and forty-seven 3,124-5,280 miles of cast-iron pipes, ranging from twenty-two inches down to three inches in diameter, being connected respectively with the upper and middle supply with the seven city distributing reservoirs, which have an aggregate capacity of sixty and three-quarter million gallons.

On account of the rapid increase of consumption of water, the company is now engaged in laying large circulating mains, the present one being twenty-two inches in diameter, for the purpose of increasing and better distributing the pressure all over the city.

THE REAL ESTATE OF THE SPRING VALLEY WATER WORKS

consists of thirty-four 50-vara lots in San Francisco, and lot 23x137½ on California street, between Kearny and Montgomery streets. At Lake Honda sixty-three acres. At College Hill eight and one-quarter acres. At Mountain Lake and Lobos Creek fifty-two and one-half acres. In San Mateo County: at Pilarcitos, fifty-three hundred and thirty-four acres; at San Andres, fifteen hundred acres; at Lock's Creek, eleven hundred and fifty acres, and at Crystal Springs, fifty-two hundred and eighty-five acres. Total in San Mateo County, thirteen thousand two hundred and sixty-nine acres.

WATERSHED.

From the first of January, 1868, to the first of January, 1875, the average rainfall over the the entire available watershed of the Spring Valley Water Works, was three hundred and five and one-half inches, which furnished over and above the total evaporation, for these seven years, six and one-seventh million gallons of water for every square mile of watershed for every inch of rainfall.

By constructing the lower Crystal Springs dam we will have a watershed of thirty-nine square miles, which is fully three times the area of the watershed available heretofore.

We shall postpone the immediate construction of the lower Crystal Springs reservoir, and build the so-called upper reservoir, which will give us a total of twenty-eight and four-tenths square miles.

Estimating only forty inches of annual rainfall (although the average for seven years as before stated was forty-three and one-half inches) on twenty-eight and four-tenths square miles, it will yield sixty-nine hundred and sixty-six million gallons per annum, which is at the rate of six million one hundred and thirty-two thousand gallons annually per square mile per inch of rainfall, actually caught and utilized.

YEAR.	Amount of water, in million gallons, caught every year to June 1st.	Aggregate of water caught to June 1st of every year.	Annual consumption of water exclusive of two millions daily from Lobos Creek.	Aggregate consumption to June 1st, every year.
On hand, Dec.	Millions.	Millions.	Millions.	Millions.
1st, 1875.	2,000			
1876	6,966	8,966	1,835	1,835
1877	6,966	15,932	4,325	6,160
1878	6,966	22,898	4,938	11,098
1879	6,966	29,864	5,610	16,708
1880	6,966	36,830	6,344	23,052
1881	6,966	43,796	7,143	30,195
1882	6,966	50,762	8,012	38,207
1883	6,966	57,728	8,953	47,160
1884	6,966	64,694	9,972	57,132
1885	6,966	71,660	11,068	68,200

This table shows that from the first December, 1875, to the first June, 1885, a total of seventy-one thousand six hundred and sixty million gallons will have been caught, and during the same period there will have been supplied to the city of San Francisco, sixty-eight thousand two hundred million gallons, leaving a balance on hand of thirty-four hundred and sixty million gallons, which at the rate of thirty million gallons per day (which is the estimated daily consumption in 1885) would only last one hundred and fifteen days.

It is therefore evident that during the year 1883 the construction of the large dam at Crystal Springs must be commenced, that it may be completed by the beginning of the rainy season of 1885-86, to catch the waters of the ten and six-tenths additional square miles for the seasons of 1883-84 and 1884-85, which will give June 1st, 1885, as the result of these two seasons' storage (estimating forty inches annual average of rain) twenty-six hundred million gallons per annum, making fifty-two hundred million gallons for the two years' supply, in addition to the seventy-one thousand six hundred and sixty million gallons caught during the last ten years. It should be understood that by constructing the lower dam the upper reservoir will become a part of the whole, their two surfaces being on the same level.

OUR TABLE CONTINUES AS FOLLOWS:

YEAR.	Gallons caught each year.	Aggregate caught to June 1st each year. [1885 has two years of 10 6-10ths square miles included.]	Annual consumption, exclusive of two millions daily from Lobos Creek.	Aggregate consumption to June 1st each year.
1885	million gallons.	76,860 million gallons.	million gallons.	million gallons.
1886	9566	86,426 " "	12,253	80,453
1887	9566	95,992 " "	13,523	93,976
1888	9566	105,558 " "	14,885	108,861

The above table shows that, owing to the rapid increase of consumption, the waters of the thirty-nine square miles alone will not be equal to the demand in 1888. For this reason the resources of the company must be increased, and the necessary works be commenced, by the year 1885.

The nearest supply at hand is that furnished by the coast streams, viz: San Gregorio, Purissima, and other streams on the ocean slope on one side, and the Calaveras with its branches on the other.

To make the former available, the waters of the neigboring streams can be conveyed by aqueducts and short tunnels into the bed of San Gregorio Creek, whence, at an elevation of about four hundred feet, the water can be conducted through a tunnel about four miles in length to a point in Bear Gulch, near Searsville, and thence by a short aqueduct over the low divide between the San Francisquito Creek and the Cañada Raymundo into the Crystal Springs reservoir. By means of this tunnel about sixty square miles of watershed, having an average annual rainfall of about forty-five inches, would be brought into use, representing a capacity of sixteen thousand five hundred and fifty million gallons per annum.

To make Calaveras practically available for the purposes of the Spring Valley Water Works, a dam of about one hundred and ten feet in height, which is only sixteen feet higher than our present San Andres dam, should be built in the narrow gorge below Calaveras Valley, thus making a reservoir that will contain about twenty thousand million gallons, and its base will be at an elevation (Aneroid measure) of five hundred and sixty feet above tide water.

A tunnel two miles in length will conduct the water through the ridge from a point in the reservoir at a low depression south of Capt. Ellis' house to a gulch east of Milpitas, its inlet being located forty feet above the bed of the creek to allow for the accumulation of sediment, there being an available depth of sixty-five feet of water above the inlet of the tunnel; the entire length of the tunnel to be bricked in cement. On the border of the lake a shaft of masonry will be sunk down to the tunnel, containing the gates for regulating the flow of the water, as also fish-screens and charcoal filters. At this shaft a pipe five feet in diameter starts and extends the entire length of the tunnel (thereby utilizing the sixty-five feet of water pressure in the lake); thence descending on a gentle slope into the Santa Clara Valley; thence with a gentle southerly sweep past Milpitas and Alviso around the head of the bay, avoiding the marsh lands, and thence to a prominent knoll on the northern bank of the San Francisquito Creek, having an elevation of five hundred feet above the bay; the pipe, including the piece in the tunnel, forming a huge inverted syphon of twenty-two miles in length.

The water is received at the outlet of the pipe by an aqueduct having a grade of two feet per mile, and running first in a westerly, and then in a northwesterly direction along the

eastern side of the Cañada Raymundo, to the San Andres reservoir, where it would discharge its full capacity over the top of the dam, and when not required in the San Andres, could be diverted into the Crystal Springs reservoir by simply opening a waste gate in the side of the aqueduct at that point.

When the surface of Calaveras Lake is at high water mark, the pipe will carry fifty-three and one-half million gallons every twenty-four hours; and when it is at its lowest level, so that it freely runs into the tunnel without a head, the pipe will carry forty-one and a half million gallons, making the average capacity forty-seven and a half million gallons per day.

Counting only five and eight-tenths million gallons caught annually per inch of rain per square mile in Calaveras, instead of six and one-seventh million gallons, which we obtain on the other side of the bay, (which reduction fairly allows for the extra evaporation in the Calaveras District,) we will have an annual yield of twenty thousand one hundred and fifty-five million gallons, which is about the capacity of the proposed Calaveras reservoir, with twenty-five inches average annual rainfall, which is below the average of the last three years.

At its average of forty-seven and a half million gallons per day, the pipe would deliver seventeen thousand three hundred and thirty-seven and a half million gallons per annum which would be discharged into either the San Andres or Crystal Springs reservoirs, leaving over twenty-eight hundred million gallons in the Calaveras reservoir annually; but as we shall construct a lower outlet for Crystal Springs reservoir separately, the daily capacity of the pipe would rise to sixty-four and a half million gallons, or twenty-three thousand five hundred and forty-two and a half millions annually. Therefore the pipe's annual discharge into San Andres alone being seventeen thousand three hundred and thirty-seven and a half million gallons, and its annual discharge into the Crystal Springs reservoir alone being twenty-three thousand five hundred and forty-two and a half million gallons, its average annual discharge would be twenty thousand four hundred and forty million gallons, or fully the product of an entire average rainy season at Calaveras.

The Calaveras system, with proper development, will furnish the nearest large reservoir to be found, that is available for your purposes, in which to store the product of large freshets, and thus enable us to gradually distribute the water through the dry seasons.

Upon close examination I have found the rock in the range dividing the Calaveras from the Santa Clara Valley to be of such a character as to admit of no seepage or leakage into the latter, a fact which the two miles of tunnel diagonally through this very range will prove to your full satisfaction.

As mentioned above, about the year 1885 the construction of additional works, either San Gregorio or Calaveras, will have to be commenced, in order to keep up with the rapidly growing supply. Should the San Gregorio be selected, it will furnish sixteen thousand five hundred and fifty million gallons, provided the whole could be caught, or forty-five and one-fourth millions daily. The Calaveras would furnish through five-foot pipe all its water, or twenty thousand one hundred and fifty million gallons annually, or fully fifty-five million gallons daily; while the original Spring Valley would furnish nine thousand five hundred and sixty-six million gallons annually, or twenty-six and one-fourth million gallons daily.

This would give us for Spring Valley and San Gregorio connected, twenty-six thousand one hundred and sixteen million gallons annually, or seventy-one and one-half million gallons daily, while if all three schemes are connected, we should have the following supply:

	Annually.	Daily.
Spring Valley	9,566 millions.	26¼ millions.
San Gregorio	16,550 "	45¼ "
Calaveras	20,150 "	55 "
Total	46,266 millions.	126½ millions.

We thus obtain a perpetual daily supply of one hundred and twenty-six and one-half millions, while we have a storage capacity of over one hundred and eighty-six millions per day for three hundred and sixty-five days.

THE TABLE OF ANNUAL CONSUMPTION CONTINUES AS FOLLOWS:

YEAR.	Total caught up to June 1st.	Water consumed annually, exclusive of two million gallons daily from Lobos Creek.	Aggregate consumed up to June 1st, every year.
1886	86,426 million gallons.	12,253 million gallons.	80,453 million gallons.
1887	95,992 " "	13,523 " "	93,976 " "
1888	....	14,885 " "	108,861 " "
1889	.....	16,341 " "	125,202 " "
1890	....	17,896 " "	143,098 " "
1891	....	19,553 " "	162,651 " "
1892	....	21,316 " "	183,967 " "
1893	.....	23,188 " "	207,155 " "
1894	....	25,174 " "	232,329 " "
1895	....	27,276 " "	259,605 " "
1896	.....	29,499 " "	289,104 " "
1897	... .	31,846 " "	320,950 " "
1898	.....	34,321 " "	355,271 " "
1899	....	36,927 " "	392,198 " "
1900	.....	39,668 " "	431,866 " "

If an annual supply of twenty-six thousand one hundred and sixteen million gallons, comprising Spring Valley and San Gregorio and adjoining streams, should be furnished from June 1st, 1887, to June 1st, 1899, we should have caught for these twelve years twelve times twenty-six thousand one hundred and sixteen million gallons, or three hundred and thirteen thousand three hundred and ninety-two million gallons in addition to the ninety-five thousand nine hundred and ninety-two million gallons, making a total, June 1st, 1899, of four hundred and nine thousand three hundred and eighty-four million gallons, while up to that date there was consumed a total of three hundred and ninety-two thousand one hundred and ninety-eight million gallons, leaving a surplus in the reservoirs of seventeen thousand one hundred and eighty-six million gallons. There being no suitable reservoir sites on the coast streams of sufficient dimensions to catch the bulk of the waters furnished by freshets, the aqueduct from these will have to be very large in order to catch the amount of water alluded to in these calculations, as otherwise during a freshet a great deal of water will run to waste into the ocean after the aqueduct is running full.

The advantage that the Calaveras has over the San Gregorio is the large compensating reservoir which would store the product of the freshets and allow it to be evenly distributed over the summer season.

Much has been said of late against the watershed or catchment system, and in favor of running rivers, but during my late trip through the East and Europe, I became convinced that water drawn from natural lakes or from large and deep artificial reservoirs, was more suitable for city supply, and purer than that drawn from rivers, however large, which drain extensive areas of agricultural and manufacturing districts, and which hold in suspension a great deal of vegetable and mineral impurity. Examples of this may be seen in the water furnished to some of our Eastern cities, and also in that supplied to London and Paris.

The city of Glasgow, in Scotland, on the other hand, being the best supplied city in the world, draws a large and never-failing supply from Loch Katrine, a clear and extensive mountain lake at a high elevation, comparatively near the city.

We have lakes similar to Loch Katrine in our own State, but it would cost an outlay of from twenty-five to forty million dollars to bring from them to San Francisco a sufficient supply of water for the next fifteen years, or say fifty millions per day.

The mountains in the vicinity of the coast at a short distance from San Francisco, being of sufficient height, and having a proportionately large rainfall and admirable reservoir

sites, the company have accomplished the next best thing to a natural lake supply, by making large artificial lakes, and thus retaining the water which would otherwise be running to the sea.

The Cañada Raymundo seems to have been originally a lake of large extent, until the water rose to such a height that it forced an outlet near the old Crystal Springs Hotel. Gradually, perhaps during thousands of years, this channel was worn down to its present level, the San Mateo creek.

Supposing that the natural barrier which in ancient times formed this lake in the Cañada Raymundo was intact at the present day, forming a large lake of nine or ten miles in extent, and containing forty to fifty thousand millions gallons of water, it would be folly not to avail of it for supplying San Francisco, and go hundreds of miles into the Sierra Nevadas for the purpose of getting a so-called running supply from one of the mountain streams at an immense expense, simply for the purpose of having running water in preference to stored water.

I simply cite this Cañada Raymundo to show what the company has been doing during the past year at Pilarcitos and San Andres, and intend to do at Cañada Raymundo and Calaveras, and that is to replace in a very substantial manner the barriers that originally formed the lakes, and add thereto safe waste weirs of cast iron and mason work, so as to control the freshets during the time the lakes are filled.

Yours respectfully,

H. SCHUSSLER,
Chief Engineer Spring Valley Water Works.

San Francisco, June 16th, 1875.

REPORT OF THE CITY SUPERINTENDENT SPRING VALLEY WATER WORKS.

To Charles Webb Howard, Esq.,

President Spring Valley Water Works:

My Dear Sir—In accordance with your request I submit the following report concerning the works:

There were laid during the year ending May 31, 1875, 9,490 feet of 8-inch pipe, 13,961 feet of 6-inch pipe, 7,826 feet of 4-inch pipe, and 2,790 feet of 3-inch pipe, making an aggregate of 33,986 feet, or 6 miles, 2,306 feet of pipe laid during the year.

The total amount of pipe laid in the city at this date is as follows; 9,839 feet of 22-inch pipe, 1,202 feet of 20-inch pipe, 23,487 feet of 16-inch pipe, 59,589 feet of 12-inch pipe, 11,293 feet of 10-inch pipe, 133,843 feet of 8-inch pipe, 239,367 feet of 6-inch pipe, 223,196 feet of 4-inch pipe, and 7,487 feet of 3-inch pipe. Total, 779,294 feet, or 147 miles, 3,124 feet.

SUMMARY OF ALL THE PIPE OF THE SPRING VALLEY WATER WORKS.

Cast iron pipe, all sizes, in the city	779,294 feet
Pilarcitos pipe line, 30-inch pipe, wrought iron	68,150 feet
San Andres pipe line, 30-inch pipe, wrought iron	64,000 feet
Lake Honda main, 30-inch pipe, wrought iron	2,572 feet
Lake Honda main, 22-inch pipe, wrought iron	3,744 feet
Lock's creek line, 37½-inch pipe, wrought iron	3,718 feet
Lock's creek line, 22-inch pipe, wrought iron	11,902 feet
Or nearly 177 miles	933,380 feet

Total length of service pipe, about 105 miles, making over 282 miles of pipe in use.

The pipes laid in the city are of the very best quality, being the heaviest used for water pipe. Their average weight are, 3-inch, 13 pounds; 4-inch, 20 pounds; 6-inch, 36 pounds; 8-inch, 42 pounds; 10-inch, 70 pounds; 12-inch, 75 pounds; 16-inch, 112 pounds; 20-inch, 196 pounds; 22-inch, 220 pounds per foot in length. They are nearly all made twelve feet long, cast vertically in dry sand, and coated with the best material, so as to be free from rust.

We have on hand ready for laying, 72 feet of 22-inch pipe, 2,004 feet of 16-inch pipe, 272 feet of 12-inch pipe, 12 feet of 10-inch pipe, 13,690 feet of 8-inch pipe, 5,801 feet of 6-inch pipe, 16,364 feet of 4-inch pipe, and 5,080 feet of 3-inch pipe, making together 40,223 feet of pipe on hand. We have on the way 5,000 feet of 12-inch, 8,512 feet of 8-inch, 12,716 feet of 6-inch, 5,000 of 4-inch, and 5,000 feet of 3-inch, making a total on hand and on the way of 76,451 feet, which we can lay during the next year, adding greatly to the income of the company.

NEW MAIN FROM VALENCIA STREET AND MARKET TO POTTER.

There is now being manufactured at the San Francisco Boiler Works, 9,500 feet of 22-inch heavy wrought iron pipe; it will be laid during the coming month on Valencia street, from between Twenty-sixth and Twenty-fifth streets to Market street, and on Market street from Valencia to Potter streets, branching then into two 12-inch mains on Market and Potter streets; also, connecting on several other streets on the way. The 16-inch pipe on Valencia street can be taken up and laid on Fourteenth street to Harrison street, and on Harrison street, say to Fifth or Fourth street, which will greatly add to the pressure in all the mains in the lower part of the city. The pipe is being made equal to the best boiler work, and tested by water pressure.

The Pilarcitos or San Andres conduits are in as perfect condition as they were on the day they were laid. The Lobos Creek pipe line (36-inch cement pipe).

Length of cement pipe and tunnel at Fort Point	8,889 feet.
Black Point tunnel	2,800 feet
Flume from Lobos Creek to Fort Point	12,016 feet.
Total length	23,705 feet.

Supplies fully two millions daily.

SERVICE CONNECTIONS.

The service connections that have been made during the year are as follows: June (1874), 114; July, 106; August, 117; September, 107; October, 106; November, 96; December, 103; January (1875), 84; February, 109; March, 126; April, 162; May, 140. Total, 1,370.

Meters.—There are 613 meters in use. There are 129 meters on hand. They are all of the Worthington make. Those on hand are, ⅝-inch, 62; 1-inch, 32; 1½-inch, 17; 2-inch, 15; 3-inch, 2; 4-inch, 1; total, 129. Those in use are, ⅝-inch, 407; 1-inch, 80; 1½-inch, 39; 2-inch, 78; 3-inch, 5; 4-inch, 3; total, 613; making a total of 742 meters.

Fire Hydrants.—There are 1,054 fire hydrants set in the city at this date, 173 of which were set during the past year.

CITY SUPERINTENDENT'S WATER REPORT FOR THE YEAR ENDING MAY 31, 1875.

MONTH ENDING 1874.	Used from San Andres.	Used from Pilarcitos.	Water Pumped.	Daily Average.	Total Consumption.
	GALLONS.	GALLONS.	GALLONS.	GALLONS.	GALLONS.
June 30	162,958,000	107,408,000	62,310,000	10,739,000	329,179,000
July 31	161,444,000	108,512,000	61,972,000	10,950,969	339,480,000
August 31	165,200,000	102,840,000	59,467,000	11,252,968	348,842,000
September 30	159,123,000	159,405,000	56,474,000	11,483,533	344,506,000
October 31	147,516,000	93,201,000	60,022,000	9,880,129	306,284,000
November 30	153,458,000	83,167,000	51,074,000	9,513,400	385,402,000
December 31	183,291,000	107,898,000	10,943,000	9,537,742	295,670,000
1875.					
January 31	153,491,000	71,659,000	60,330,000	9,452,710	293,034,000
February 28	146,200,000	76,103,000	59,415,000	9,983,036	279,535,000
March 31	158,240,000	98,116,000	66,555,000	10,279,133	318,653,000
April 30	167,817,000	113,761,000	62,400,000	11,551,600	346,548,000
May 31	198,283,000	114,338,000	63,185,000	12,549,000	376,470,000
Grand Total	1,956,021,000	1,236,408,000	674,147,000	10,585,214	3,863,603,000

In the above table, the column headed "water pumped," represents the water pumped by the city engine at Black Point, and is the Lobos Creek water used, and so on. The line headed "grand total," represents the total amounts for the entire year.

1865—Consumption of water for year (in gallons) 863,958,000
" Daily average 2,367,010
1866—Consumption of water for year 1,113,863,000
" Daily average 3,051,652
1867—Consumption of water for year 1,347,691,000
" Daily average 3,692,305
1868—Consumption of water for year 1,577,652,000
" Daily average 4,323,978
1869—Consumption of water for year 2,003,241,000
" Daily average 5,488,332
1870—Consumption of water for year 2,204,165,000
" Daily average 6,039,808
1871—Consumption of water for year 2,411,244,000
" Daily average 6,599,869
1872—Consumption of water for year 2,730,226,000
" Daily average 7,453,000
1873—Consumption of water for year 3,138,747,000
" Daily average 8,599,383
1874—Consumption of water for year 3,518,652,000
" Daily average 9,640,142
1875—Consumption of water for year 3,863,603,000
" Daily average 10,585,214

The above table exhibits the consumption of water in the city, but it does not include the amount we have wasted during the rainy season at the lakes, which said waste, in addition to the consumption, is the amount that was furnished from the watershed connected with the San Andres and Pilarcitos Lakes, and for the particulars concerning which, see Mr. Schussler's report.

RESERVOIRS.

There are seven reservoirs in the city, used for distribution, and two large retaining reservoirs in San Mateo County. There is also in course of construction, the Crystal Springs reservoir, also in San Mateo County. They are enumerated in the following table. The first seven mentioned are in the city, and the balance are in San Mateo County :

RESERVOIRS OF THE SPRING VALLEY WATER WORKS.

Brannan street reservoir, depth 8 feet, elevation 85 feet, contents in gallons....	400,000
Francisco street reservoir, depth 14 feet, elevation 139 feet, contents.....	6,712,000
Lombard street reservoir, depth 22 feet, elevation 306 feet, contents.....	3,724,000
Clay street hill reservoir, depth 9 feet, elevation 375 feet, contents.....	141,000
Market street reservoir, depth 15 feet, elevation 196 feet, contents.....	2,250,000
Laguna Honda reservoir, depth 29 feet, elevation 377 feet, contents.....	32,918,000
College Hill reservoir, depth 18 feet, elevation 252 feet, contents.....	15,006,000
Capacity of city reservoirs.....	61,151,000
Pilarcitos Reservoir, depth 46 feet, elevation 692 feet, contents.....	1,083,121,000
San Andres reservoir, depth 89 feet, elevation 449 feet, contents.....	7,000,000,000
Capacity of retaining reservoirs.....	8,083.121,000
To which add the distributing reservoirs.....	61,151,000
Makes a total storage capacity of.....	8,144,272,000

The upper Crystal Springs reservoir when completed will contain 15,000,000,000 gallons.

The total storage capacity, when the new reservoir is completed, will be 23,144,272,000 gallons.

CITY ENGINE AND PUMPS.

The pumping works are situated at Black Point, on the 50-vara lot S. E. corner of Beach and Van Ness avenue. The 50-vara lot N. E. corner of Beach and Van Ness avenue, is used as a wharf for landing coal. The pumping works consist of two condensing engines of 250-horse power each ; four pumps, double-acting, made to run one revolution to the engine, 4.37.

Size of engine—40-inch bore, 4-feet stroke.

Size of pumps—two 14-inch bore, 7-feet stroke.

Size of pumps—two 12-inch bore, 5-feet stroke.

Capacity of pumps—75 gallons to each revolution of the engine.

Duty of engine with anthracite coal—406,000 lbs. of water raised one foot high with each pound of coal consumed.

See table of water consumption for amount of water pumped during the year.

BOILERS.

There are four boilers, 52 inches diameter, 15 feet long, 67 3-inch tubes ; steam drums, 3 feet diameter, 4 feet high. Evaporative power, 10.36 lbs. of water for every pound of coal.

Smoke-stack is built square and of brick, is 116 feet high ; its inside area is larger at the top than at the bottom, the top being 7½ feet square inside, and the bottom 5 feet.

The engines are so arranged that but one is used at a time, and run by two boilers. In fact, everything is in duplicate so that in case of any accident the pumps will not have to be stopped.

DATE.	No. 1 Pump. Upper Reservoir.		No. 2 Pump. Lower Reservoir		No. 3 Pump. Upper Reservoir		No. 4 Pump. Lower Reservoir		Number Revolut'ns	Coal Consumed.			Gallons Pumped.
	Hours.	Min.	Hours.	Min.	Hours.	Min.	Hours.	Min.	Engine.	Tons.	Lbs	Coal.	
June, 1874	674	30	674	30	674	30	674	30	830,500	118	80	Sydney	62,310,000
July, 1874	704	00	704	00	704	00	704	00	826,300	125	1800	"	61,972,000
August, 1874	708	00	708	00	708	00	708	00	792,800	126	960	"	59,467,000
September, 1874	682	00	682	00	682	00	682	00	752,900	121	160	"	56,474,000
October, 1874	692	00	692	00	692	00	692	00	800,800	123	1480	"	60,022,000
November, 1874	564	30	564	30	564	30	564	30	680,900	104	1240	"	51,074,000
December, 1874	114	00	114	00	114	00	114	00	145,600	22	720	"	10,943,000
January, 1875	633	00	633	00	633	00	633	00	804,400	115	600	"	60,330,000
February, 1875	628	00	628	00	628	00	628	00	792,200	114	1240	"	59,515,000
March, 1875	702	00	702	00	702	00	702	00	907,400	192	1120	Mt. Dia. Ser	66,555,000
April, 1875	673	00	673	00	673	00	673	00	832,000	189	1440	" "	62,400,000
May, 1875	711	00	711	00	711	00	643	00	877,200	189	1240	" "	63,185,000
Total	7,486	00	7,486	00	7,486	00	7,418	00	9,043,000	1,543	980/2240		674,147,000

LIST OF REAL ESTATE IN SAN FRANCISCO COUNTY BELONGING TO THE SPRING VALLEY WATER WORKS.

FRANCISCO STREET RESERVOIR PROPERTY, IN BLOCK 292.—Francisco Street Reservoir Property, in Block 292 of City Land; 50-vara lot No. 1434, S. E. cor. Francisco and Larkin streets; 50-vara lot No. 1345, south side Francisco, between Hyde and Larkin streets; 50-vara lot No. 1252, S. W. cor. Francisco and Hyde streets.

LOMBARD STREET RESERVOIR PROPERTY, IN BLOCK 294.—50-vara lot No. 776, N. W. cor. Chestnut and Hyde streets; 50-vara lot No. 778, north side Chestnut, between Hyde and Larkin streets; 50-vara lot No. 780, N. E. cor. Chestnut and Larkin streets; 50-vara lot No. 781, S. E. cor. Lombard and Larkin streets; 50-vara lot No. 779, south side Lombard, between Hyde and Larkin streets; 50-vara lot No. 777, S. W. cor. Lombard and Hyde streets.

IN BLOCK 28, W. A.—50-vara lot No. 6, S. W. cor. Chestnut and Larkin streets, in Block No. 29, Western Addition; 50-vara lot No. 2, north side Chestnut, between Larkin and Polk streets; 50-vara lot No. 3, N. E. cor. Chestnut and Polk streets; 50-vara lot No. 4, S. E. cor. Francisco and Polk streets.

IN BLOCK 293.—50-vara lot No. 804, N. E. cor. Lombard and Larkin streets.

FRANCISCO STREET RESERVOIR PROPERTY, IN BLOCK 291.—50-vara lot No. 1160, N. W. cor. Francisco and Hyde streets; 50-vara lot No. 1346, north side Francisco, between Hyde and Larkin streets; 50-vara lot No. 1435, N. E. cor. Francisco and Larkin streets; 50-vara lot No. 1436, S. E. cor. Bay and Larkin streets; 50-vara lot No. 1437, north side Bay street, between Hyde and Larkin streets; 50-vara lot No. 1161, S. W. cor. Bay and Hyde streets.

CITY ENGINE PROPERTY, IN BLOCK 37, W. A.—50-vara lot No. 3, N. E. cor. Beach and Van Ness avenue (wharf).

IN BLOCK 38, W. A.—50-vara lot No. 4, S. E. cor. Beach and Van Ness avenue (city engines).

CLAY STREET HILL RESERVOIR PROPERTY, IN BLOCK 245.—50-vara lot No. 828, S. W. cor. Washington and Jones streets, 137:6x120.

MARKET STREET RESERVOIR PROPERTY—Bounded by Market, Buchanan, Kate and Church streets. Described as follows: Commencing at the S. W. corner of Buchanan and Kate streets; S. 351 feet to N. W. line of Market street; S. W. 372 feet 5 in.; S. 85 deg. 30 min. W. 143 feet; N. 53 deg. 30 min W., 195 feet; N. 52 deg. W., 100 feet; N. 45 deg. 30 min. W., 45 feet; N. 36 deg. 5 min. W., 38 feet; N. 23 deg. 30 min. W., 59 feet; N. 10 deg. 15 min. W., 8 feet; N. 5 deg. 45 min. W., 23 feet; N. 1 deg. 40 min. W., 182 feet, to line of Kate street; E. 668 feet 6 inches to place of beginning; being 7 413-1000 acres.

IN BLOCK 215.—S. E. cor. Kate and Buchanan, 25x100 feet; 25 feet on Kate street and 100 feet on Buchanan street.

BRANNAN STREET RESERVOIR PROPERTY—IN BLOCK 65, POTRERO LANDS.—Entire block bounded by Potrero avenue, Center, Santa Clara and Jersey streets, 200x400 feet.

OFFICE PROPERTY.—Lot north side California street, 137 feet 6 inches west of Montgomery street: west 22 feet 3 inches by 137 feet 6 inches.

BERNAL HEIGHTS—COLLEGE HILL RESERVOIR LOT.—Lot on the N. W. cor. Park and West avenues; W. 64 feet, N. 534 feet, E. 460 feet, S. 524 feet, to point of beginning, being portions of lots 34, 35, 37 and 38, containing 7 84-100 acres.

ABBEY HOMESTEAD PROPERTY—SAN MATEO COUNTY.—Lot No. 9 in block No. 11, 100x100 feet; lot No. 12 in block No. 83, 100x100 feet; lots No. 4 and 16 in block No. 100, 100x100 feet; lots No. 7 and 13 in block No. 101, 100x100 feet; lot No. 10 in block No. 102, 100x100 feet, and lot No. 2 in block No. 104, 100x100 feet.

MARIN COUNTY PROPERTY.—(Formerly Saucelito Water and Steam Tug Company's Property.) Situated in the town of old Saucelito; described as follows: lots numbered eleven (11), twelve (12), thirteen (13) and fourteen (14), in block numbered six (6); lots numbered sixteen (16) and seventeen (17), in block numbered ten (10); lots numbered six (6), seven (7), sixteen (16), and seventeen (17), in block numbered fourteen (14); and lots numbered three (3), four (4), five (5), eleven (11), twelve (12), and thirteen (13), in block numbered

sixteen (16), as shown on the map of said town of Saucelito, surveyed by Lieut. Emmens of the U. S. N., June 8th, 1851.

LAGUNA HONDA PROPERTY—63 ACRES.—Mountain Lake and Lobos creek property—52½ acres.

Yours respectfully,

CHAS. ELLIOT,
City Superintendent.

SAN FRANCISCO, June 16, 1875.

REPORT OF THE SECRETARY OF THE SPRING VALLEY WATER WORKS.

TO CHARLES WEBB HOWARD, ESQ.,

President Spring Valley Water Works:

MY DEAR SIR—Since the last annual meeting, the increase of the business of the company has been very gratifying. My experience with the company dates from its incorporation, and the past year has been the largest yearly increase that we have had. The large number of houses erected, together with the large number in process of erection, has made it necessary to increase our force in all the various city departments. We have doubled the force in the service connection, or tapping department, and still it is difficult at times to accommodate the applicants as speedily as they desire.

The collections for the year, from water rents and service connections, have been as follows:

1874—In June	$ 88,765 35	
1874—In July	88,430 12	
1874—In August	87,554 32	
1874—In September	90,889 36	
1874—In October	91,164 40	
1874—In November	88,746 46	
1874—In December	104,267 00	
1875—In January	81,789 15	
1875—In February	86,308 76	
1875—In March	93,840 50	
1875—In April	94,332 88	
1875—In May	94,545 88	
Making a total of		$1,090,634 18
Less the amount received for service connections		19,000 55
Making the total water rents		$1,071,633 63

The gain in the monthly revenue, since May, 1874, is $9,306 26. The company has furnished 3,605 gallons of water for every dollar that it has received during the year for water rents. The present monthly expense for maintenance and the running of the works is about $8,300. The total receipts from all sources have been $1,397,729 41. The total disbursements have been $1,603,859 73. The floating debt of the company is $387,559 90, occasioned by the purchase of land for the Crystal Springs reservoir and the work thereon, as also the completion of the San Andres dam.

The stock of the Spring Valley Water Works has never been watered, unless it can be said to have been in March, 1868, when it was increased 20,000 shares, and divided pro rata among the stockholders, who paid $58 per share for it, the $1,160,000 obtained thereby having been expended in the construction of the works.

Agreeably with your request, I have very carefully examined the books of the San Francisco City Water Works and the Spring Valley Water Works, with reference to all the moneys they have received from all sources; also, the number and amount of dividends they have paid, up to and including, March, 1875, and they plainly exhibit that the San Francisco City Water Works received, from October 31st, 1858, to, and including, October, 1865, the sum of..... $1,655,605 71

and no more.

The interest on this amount, from the time it was received up to the said 31st of March, 1875, at the rate of 10 per cent. per annum, simple interest, amounts to the sum of.....		2,226,842 66
The Spring Valley Water Works received from and including August, 1860, to and including March, 1875, from all sources, the sum of.....		11,792,884 59
The interest on this amount, at the rate of 10 per cent. per annum, simple interest, from the time it was received to the 31st of March, 1875, amounts to..		6,783,550 83
Making a total of.....		$22,458,883 79
The total amount of dividends paid by the said companies are as follows:		
The San Francisco City Water Works paid from, and including, July, 1861, to and including, January, 1865, eight dividends, amounting in the aggregate to.....	$247,155 00	
The interest on the said dividends, from the time they were paid to the said 31st of March, 1875, at the rate of 10 per cent. per annum, simple interest, amounts to.....	315,618 23	
The Spring Valley Water Works paid from, and including, August, 1863, to and including, February, 1875, one hundred and eighteen dividends, aggregating.....	4,454,407 18	
The interest on these dividends, at the rate of 10 per cent. per annum, simple interest, from the time paid to the 31st of March, 1875, amounts to.....	1,963,454 72	
Total dividends and interest is.....		$6,980,635 13
And which, deducted from the assessments and receipts from all sources, with interest, as aforesaid, leaves.....		$15,478,248 66

Which was the actual cost of the works on the 31st day of March, 1875.

In conclusion, I would call your attention to the fact that the present office is entirely too small for the transaction of the business of the company.

Yours respectfully,

E. M. MILES, Secretary.

San Francisco, June 16th, 1875.

Spring Valley Water Works,
San Francisco, July 29, 1875.

Charles Webb Howard, Esq.,
President Spring Valley Water Works:

Dear Sir: Can you give me an approximate estimate of the monthly or annual expense of the company? Also, are you disposed to make any change in the price named for sale of company's property to the city?

Yours respectfully.

JAMES OTIS,
Chairman Committee.

SPRING VALLEY WATER WORKS,
SAN FRANCISCO, July 30, 1875.

HON. JAMES OTIS, *Chairman:*

MY DEAR SIR: Your favor of the 29th instant is at hand. The monthly expenses of the Spring Valley Water Works are from $8,200 to $8,500, or, say $100,000 per annum.

I am not disposed to make any change in the price, but beg leave to say that the one already named is very much less than we should be willing to take under ordinary circumstances.

Very truly yours,

CHARLES WEBB HOWARD,
President Spring Valley Water Works.

On the reading of the foregoing report from the Committee, the following Resolution (No. 7,645), was introduced by and on motion of Supervisor Lynch, unanimously adopted:

Resolved, That the Report of the Committee consisting of the Mayor, Auditor and City and County Attorney, in the matter of the purchase of the Spring Valley Water Works, and their action and recommendations thereon, presented and read at this meeting, as to the price demanded by said corporation for their property, meets the entire approval of this Board.

It being the expressed opinion of the members of the Board, as stated in the report submitted, that the price named was much in excess of the true cost of the works and in excess of their real value.

At the same meeting, July 30, 1875, on motion of Supervisor Block, the resignation of T. A. Scowden, Esq., Engineer in the matter of water supplies, was accepted to take effect August 1st, and a Resolution introduced by Supervisors Hewston and Block, providing for repealing Resolution No. 7,448, whereby it was declared to be expedient and proper to purchase the water, water rights, and property of the Spring Valley Water Works was, after discussion, withdrawn in order to obtain the opinion of the City and County Attorney as to the power of the Board in the premises.

On August 2, 1875, a communication from, with opinion of the City and County Attorney, was received, stating that in reference to the report of the committee in the matter of the purchase of the Spring Valley Water Works, the Act of March 30, 1874, required that when the report of the committee had been made and filed, it became the duty of the Board to cause the material parts thereof (except maps and surveys) to be published in three daily newspapers for thirty days; also, desired to give further consideration before expressing an opinion upon the question, as to whether the Board had power to repeal Resolution No. 7,448, and the effect of such proposed repeal if such power existed.

On the 11th of October, 1875, the opinion of the City and County Attorney was received in reference thereto, in which he states that as "to the power of the Board of Supervisors to repeal Resolution No. 7,448, whereby it was declared to be expedient and proper to purchase the water, water rights and property of the Spring Valley Water Works, I beg to state that the repeal by

the Board of that resolution would have no effect to stop the proceedings prescribed by statute, to be pursued after and consequent upon the passage of the resolution. The statutes very plainly lays down the several steps to be taken by the Board of Supervisors and other Boards of officers after the passage of such a resolution as the one above mentioned, but I can no where find any power conferred upon that Board (of Supervisors) to stop the proceedings by a repeal of the original resolution or otherwise, after, as in this instance, there shall be an inability on the part of the committee consisting of the Mayor, Auditor and City and County Attorney, to agree with the owner or owners of the property sought to be acquired. The next step prescribed is the publication of the material parts of the report of that committee, pursuant to section two of the Act of March 30, 1874."

The Board in declaring it to be expedient and proper to purchase the Spring Valley Water Works was under the impression, as expressed by the members that the property and works and water-rights of said corporation could be purchased by the city at a fair and reasonable figure, and on the report of the Committee consisting of the Mayor, Auditor and City and County Attorney, being made as to the price demanded, the members unanimously sustained the report as to the excessive valuation placed by the Spring Valley Water Works on their property; and by omitting to further perform the acts required by the Act of the Legislature on the coming in of said report, virtually announced that it was not expedient, advisable or proper to purchase said works, either at the price named, or by proceeding to condemn the said property, the mode as prescribed by said Act of the Legislature on the appointment of Commissioners and in the concurrence required, not being apparently in the judgment of the Board a guarantee, that any better result for the city as to the value could be arrived at, than determined by the Spring Valley Water Works.

G. F. Allardt, Esq., Assistant Engineer of Water Supplies, with several employees, were retained by the Special Committee until October 11th, 1875, to complete the maps, profiles, etc., of the various surveys. On that date, the following communication announcing the completion of the work was presented by Supervisor Deering, to-wit:

ENGINEER'S OFFICE CITY WATER SUPPLY,
SAN FRANCISCO, October 11th, 1875.

JAS. H. DEERING, ESQ.,
Chairman of Committee on Water Supply:

DEAR SIR: I beg leave to report to your Honorable Committee that I have this day completed all the maps, profiles and field notes pertaining to the surveys of the City Water Supply, and have deposited the same, together with the surveying and drafting instruments, in the Mayor's office for safe keeping. The tents, camping material and surveying tools are stored in a small building on the new City Hall lot, and the keys of this office are in the hands of Mr. Hatherton, City Hall Architect.

Thanking you for the uniform courtesy extended to myself and assistants in the discharge of our duties, I remain,

Yours very respectfully,

G. F. ALLARDT,
Assist. Engineer in charge.

The following schedules show the expense of the water surveys, inventory of property, with list of maps, profiles and field books accompanying Engineer's report, and filed in the Mayor's office.

EXPENSES.

Total pay roll from August 24, 1874, to October 11, 1875	$39,293 98
Field expenses	14,873 59
Office expenses	1,431 15
Instruments, implements and camp equipage	2,012 71
Total expense	$57,611 43

LIST OF MAPS, PROFILES AND FIELD BOOKS ACCOMPANYING THE ENGINEER'S REPORT FILED IN MAYOR'S OFFICE.

Blue Lakes—Maps Nos. 1, 2, 3, 4, 5 and 6; profiles Nos. 1, 2, 3, 4, 5 and 6; 1 general profile, and 37 field books.

Clear Lake—Maps Nos. 1, 2, 4 and 5; profiles Nos. 1. 2, 3, 4 and 5; 1 profile of Carquinez Straits; 1 profile of San Francisco Bay, and 23 field books.

Spring Valley—1 map; 1 profile, and 4 field books.

Laguna Merced—1 map, and 3 field books.

Calaveras Valley—3 maps and 3 profiles; cross sections of reservoir; cross sections for water gauges, and 19 field books.

Pescadero Creek—1 map; 2 profiles, and 4 field books.

Rock Creek Reservoir—1 map; 1 profile; cross sections of dam, and 5 field books.

Also, 2 maps of California; 1 map of San Francisco; 1 general map of water supply, scale 10,000 feet to the inch, and 1 general map of water supply, scale 6 miles to the inch.

INVENTORY OF PROPERTY DEPOSITED IN MAYOR'S OFFICE.

3 boxes drafting instruments (complete).
2 beam compasses.
2 German silver protractors.
1 proportional divider, in box.
2 pr. dividers, in boxes.
1 hand level.
1 box dividers (spring).
1 leveling instrument.
3 transit instruments.
4 tin boxes, for papers.
1 steel straight edge.
1 wood straight edge.
1 T square.
1 parallel ruler.
1 2-foot triangular scale.
2 12-inch flat scales.
3 steel triangles.
7 wooden triangles.
1 rubber triangle.
1 architect curve.
4 marking irons.
1 tape, 50 feet.
1 aneroid.
1 miscellaneous lot of stationery.
1 desk ruler.
3 12-inch triangular scales.
1 slope level.

Five tents, and a miscellaneous lot of camping materials, consisting of stoves, cooking utensils, etc., stored in a small building on new City Hall lot.